

MINOR THESIS

**A Survey of Some Commercial Apple Orchards
in Virginia**

A. W. Brinkard Jr

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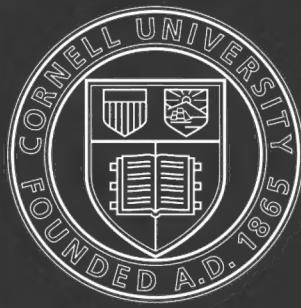
NEW YORK STATE COLLEGES
OF
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A SURVEY ~~TO~~ SOME COMMERCIAL APPLE ORCHARDS
IN VIRGINIA.

Minor Thesis.

Submitted to Professor John Craig, Professor
of Horticulture, as a report of work done on first
minor subject for the degree of Doctor of Philosophy
in the Graduate School of Cornell University.

By

A. W. ²Drinkard, Jr., B. S., M. S.
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Cornell University

July, 1912.

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A SURVEY OF SOME COMMERCIAL APPLE ORCHARDS IN VIRGINIA.

This survey represents a part of my graduate work on a minor subject in the Department of Horticulture. Professor John Craig suggested the problem, outlined the scope of the investigation and kindly supervised and criticised the work during its progress, and I wish to acknowledge the benefit I have derived from his helpful suggestions.

This is the first survey that has been attempted to ascertain the conditions in the Virginia apple orchards. Such investigations have been conducted elsewhere far more thoroughly than this survey. Under Professor Craig's direction, the leading fruit-growing counties of New York State have been surveyed and the results of the investigations published in Cornell Agricultural Experiment Station Bulletins 226, 229, 262 and 307.

There are several reasons why a survey of the apple orchards of Virginia is desirable. (1) The fruit growers in any given locality desire to know how the fruit growers in other localities are conducting the business. There is no line of agricultural work in which the experience of the "other fellow" is more helpful than in the growing

of apples. A knowledge of current practices is highly essential to success. (2) Persons who are interested in entering the orchard business desire to have all available information concerning that business in the locality where they would invest their capital. A survey such as this one brings together facts which this class of persons is seeking. (3) Persons and institutions desiring to advance the horticultural interests of the State can the better accomplish this end when they have at hand accurate data bearing on orchard conditions. The Virginia Agricultural Experiment Station frequently has requests for information concerning the adaptation of varieties, and current orchard practices in the State, and I believe this survey will materially assist in answering many of these questions. This survey is by no means as extensive as might be desired. I hope that it is but the beginning of a more detailed survey which will enable us ultimately to know the average cost in this State of producing a barrel of apples, and the average profit that may be expected from it.

In April, 1911, I addressed five hundred circular letters to fruit-growers in Virginia. The cordial attention which the fruit growers gave my letters was very gratifying to me. The growers were kind enough to answer at length the series of questions which I submitted to them, and I

wish to acknowledge at this time my obligation for the courtesy. I hope that at some future time the information brought together in this report may be available to the fruit growers of the state. The answers which I received furnish the basis for this paper. Nearly three hundred replies were received, of which two hundred and fifty-three gave information that could be utilized in this paper.

Distribution of the Orchards Reported on in This Survey. It is difficult to state in definite terms the distribution of the orchards reported on in this survey, for one county may lie partly in one region of the State and partly in another. When classified according to the geographical regions of the state we find the orchards falling into the following groups:

The Piedmont and Blue Ridge regions embrace about	50%
The Valley region embraces about	45%
The Middle Virginia region embraces about	4%
The Appalachian region embraces about	1%

Distribution of Orchards. - Distribution by counties of the orchards reported in this survey is shown below. Both the counties and the number of orchards reported from these counties are given.

County	Number of Orchards
Augusta	34
Albemarle	33
Rappahannock	22
Frederick	20
Nelson	18
Roanoke	13
Rockingham	11
Shenandoah	11
Loudoun	11
Bedford	9
Franklin	9
Botetourt	7
Wythe	7
Clarke	6
Warren	5
Patrick	5
Montgomery	4
Rockbridge	4
<i>J</i> Fauquier	3
Amherst	2
Pulaski	2
Orange	2
Page	2
Smyth	2
Alleghany	1
Campbell	1
Halifax	1
Buckingham	1
Spotsylvania	1
Caroline	1
Fairfax	1
Henrico	1
Surry	1
Prince William	1
Culpeper	1
Total Number	253

The same date is shown in Fig. 1. This illustration is copied from Alwaod's publication on the fruit soils of Virginia, which will be cited later. This map shows the reader at one glance the location of the fruit growing regions of the State.

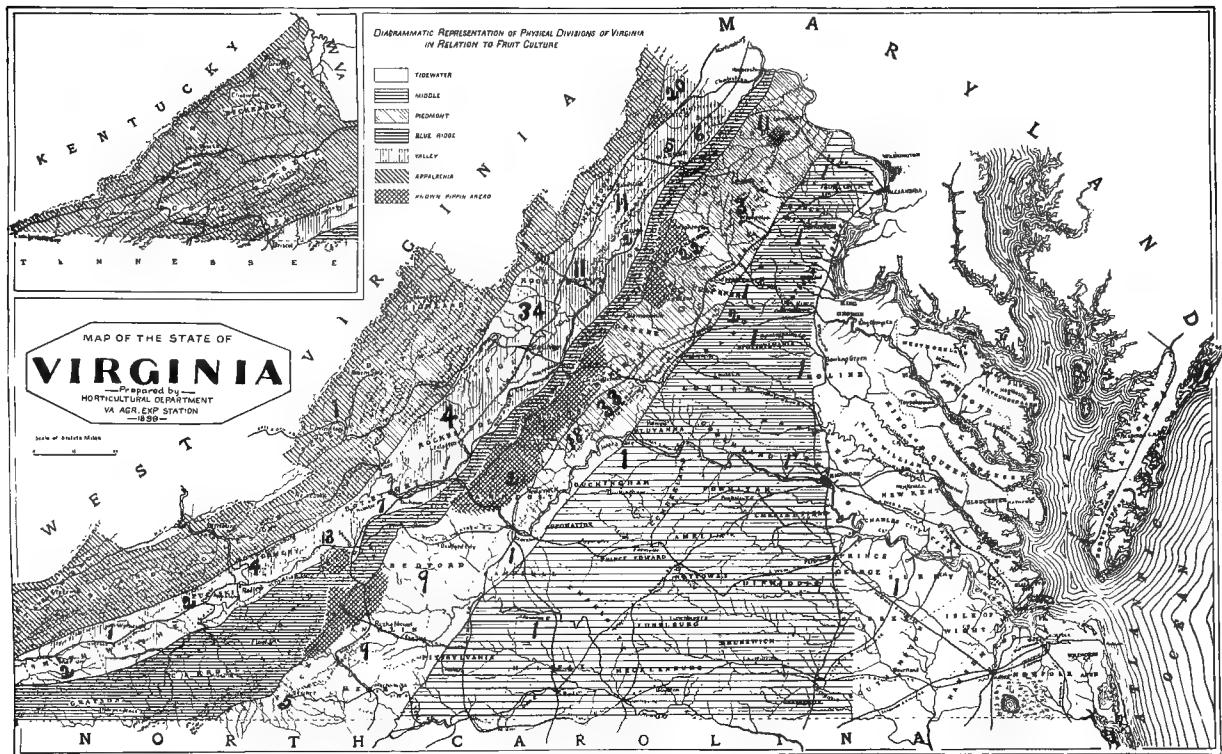


Fig. #1. Map of Virginia showing the physical divisions of the state. (After Alwood). The bold type figures are mine and show the location by counties of the orchards which comprise this survey.

Fig. 1 shows that replies to my letters came from thirty-five counties. It may be pointed out, however, that 71 per cent of all the replies came from the first ten counties on the list. The larger number of replies came from those counties in which the apple industry has been longest established, and best developed.

Acreage. - In order that a survey of this kind may have value as an index by which the actual conditions may be judged, it is necessary that the survey extend over a considerable area. It would be desirable to have data on a still greater area than that which is represented in this report. Yet the area reported is large enough to furnish reliable information. Two hundred and forty-four fruit growers stated the extent of their orchards. The aggregate acreage of all these orchards, including both young and old, amounts to 12,419 acres.

Size of Orchards. - The orchards vary greatly in size, ranging from two acres to five hundred acres; however there are few orchards around either of these outlying extremes. Fig. 2 shows the distribution of the orchards according to size. The average size of all these orchards is approximately fifty acres. It might be stated that several very large orchards are reported, which tend to make the average acreage high. Thirty-two of these orchards

contain as much as one hundred acres each.

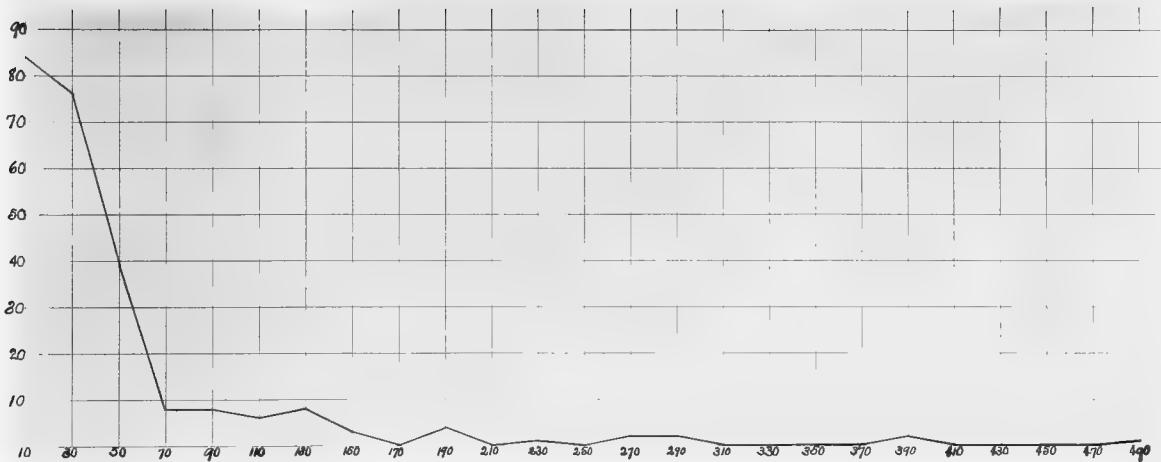


Fig. 2. Diagram to show the distribution of orchards according to size. Figures on the base line show the size of the orchards, grouped into classes, with a class range of 20 acres. The figures on the vertical line show the number of orchards which fall in any particular class.

THE QUESTION OF VARIETIES.

One of the difficult questions which every fruit-grower has to meet is that of choosing the right varieties for his orchard. In my circular letter to the growers, I asked three questions about varieties. It is desirable to know what are the leading varieties in both the old or bearing orchards, and also the leading varieties in the young orchards which have not yet reached the bearing stage. Data on these two points will enable us to see the trend of the plantings, and show from the growers' point of view the relative value of the different varieties for commercial orchards. Then, in order to get the growers' latest judgment, a question was asked relative to future plantings. Since the same variety is reported under different names by different growers, it will be worth while to take up the question of nomenclature at this point.

A List of Varieties Mentioned in This Survey.

Many varieties have several names. Authorities in pomological nomenclature recognize only one name for a variety, and the other names by which it may be recognized in different localities become synonyms. For many reasons the growers should designate a variety by its correct name; this matter is important when apples are entered for competitive exhibitions and it should be guarded also when marking apples for market. In the list which follows, I have placed in the

first column the names of varieties reported by the growers; in the second column just opposite the first, I have written the correct names of the varieties. This nomenclature is taken from the following authorities:

Ragan, W. H., Nomenclature of The Apple. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin No. 56. (1905)

Beach, S. A., et al., The Apples of New York.

2 vols. (1905). In a few cases I was unable to find reference to the variety mentioned by the growers; and in such cases the second column has been left blank. Throughout this paper the varieties will be referred to by their correct names.

Name Given by the Growers	Correct Name.
America	America
American Beauty	American Beauty
Albemarle Pippin	Albemarle
Arkansas Black	Arkansas Black
Baldwin	Baldwin
Baltzley	Baltzley
Belmont	Belmont
Ben Davis	Ben Davis
Black Ben Davis	Black Ben Davis
Bonum	Bonum
Buckingham	Buckingham
Cannon	Cannon
Cannon Pearmain	Cannon Pearmain
Champion	Collins
Commerce	Commerce
Delaware Red Winter	Delaware Red
Delicious	Delicious
Domini	Domine
Duchess of Oldenburg	Oldenburg
Early Harvest	Early Harvest
Early Ripe	Early Ripe

Esopus Spitzenburg	Esopus
Fallawater	Fallawater
Fall Cheese	Fall Cheese
Fall Pippin	Fall Pippin
Lawyer	(is probably Lawver)
Gano	Gano
Genetian	Ralls
Gibbs Late	Gibbs
Gilbert	Gilbert
Gloria Mundi	Gloria Mundi
Golden Gate	Golden Gate
Golden Pippin	Golden Pippin
Golden Russet	Golden Russet
Gravenstein	Gravenstein
Grimes Golden	Grimes
Ingram	Ingram
Jonathan	Jonathan
Justice	Justice
Kennards Choice	Kinnaird
Kentucky Red	Kentucky Red
King David	King David
Lady	Lady
Lankford	Lankford
Lawver	Lawver
Liveland Raspberry	Liveland Raspberry
Loudon Pippin	Loudoun
Lewry	Lowrie
Lowry Seedling	Lowrie
Maidens Blush	Maiden Blush
Mammoth Black Twig	Arkansas
Mcafe	McAfee
McIntosh	McIntosh
Missouri Pippin	Missouri
Mother	Mother
Nansemond Beauty	Nansemond
Nere	Nere
Newtown Pippin	Yellow Newtown
Northern Spy	Northern Spy
Northwestern Greening	Northwestern Greening
Ortley	Ortley
Paradise	Paradise
Paradise Winter Sweet	Winter Paradise
Piedmont Pippin	Piedmont
Pilot	Pilot
Queen	Queen
Ralls Jenette	Ralls
Rebel	Rebel

Red Astrachan	Red Astrachan
Red Streak	Redstreak
Rhode Island Greening	Rhode Island
Robinson	Robinson
Rome Beauty	Rome
Roxbury Russet	Roxbury
Royal Limbertwig	Royal Limbertwig
Russian Rambo	(is probably Rambour Reinette)
Salome	Salome
Senator	Oliver
Shockley	Shockley
Shockley Lady	(is probably Shockley)
Silver King	Silver Pippin
Silver Pippin	Smith
Smiths Cider	Smokehouse
Smokehouse	Sour Bough
Sour Bough	Springdale
South Carolina Summer	Stark
Springdale	Stayman Winesap
Stark	Summer Pippin
Stayman Winesap	Summer Queen
Summer Pippin	Summer Rambo
Summer Queen	Tolman
Summer Rambo	Tompkins King
Tolman Sweet	Vandevere
Tompkins County King	Via
Tweekesbury Winter Blush	Vine
Vandiver	Virginia Beauty
Vere	Wagener
Via	Wealthy
Vine	Winter Cheese
Virginia Beauty	Winesap
Wagener	Winter Smokehouse
Wealthy	Wolf River
Winter Cheese	Yellow Bellflower
Winesap	Yellow Transparent
Winter Smokehouse	York Imperial or Johnsons Fine
Wolf River	Winter
Yellow Bellflower	York
Yellow Transparent	York Stripe
York Imperial or Johnsons Fine	
Winter	
York	
York Stripe	

Varieties found in Bearing Orchards. - "Name the leading varieties of apples in your bearing orchard in the order of their commercial importance, giving the approximate number of each." Two hundred and twelve bearing orchards were reported, and in the aggregate they contain over a quarter of a million trees. The fruit-growers named the varieties in what they considered the order of their commercial importance. Table I briefly summarizes their answers. A word may be said in explanation of this table. In the first column under the caption "Variety", the varieties are listed in the order of their importance as shown by the number of orchards in which they are found. The second column states that the rank is. The third column gives the number of growers who have this variety in their orchards, and the fourth column states the per cent of orchards in which this variety is found. The total number of trees reported of this variety stands in the fifth column. And the per cent which this variety constitutes of the total number of trees reported in the old orchards stands in the sixth column. Then the rank which the growers gave the variety is shown; the number of growers who gave the variety any stated rank stands beneath the ordinal which heads the column representing that rank. For example, York ranks

first according to the number of orchards in which it is grown; it is found in one hundred and sixty-five (out of a total of two hundred and twelve) bearing orchards, which is 77.83 per cent of the bearing orchards; there were 86,343 trees of this variety reported, which is 34.38 per cent of all the trees of all varieties in the old orchards; seventy-seven growers placed this variety first in rank, forty placed it second, thirty-four placed it third, five placed it fourth, seven placed it fifth, one placed it sixth, and one grower placed this variety eighth in commercial importance. In like manner the reader may run through the entire table and find the rank of any given variety.

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The item "Miscellaneous" inserted at the end of the column headed "Variety" in Table 1, includes a large number of varieties which were mentioned by one or two fruit growers respectively. Since these varieties were reported by so few growers, their relative ranks would have little significance, and therefore they were not listed in the above table. These varieties were reported in small numbers ranging from ten to two hundred and fifty. Every variety mentioned in the bearing orchards and not included in the above table will be listed below:

Virginia Beauty	Yellow Bellflower
Summer Queen	Red Astrachan
Golden Pippin	Mother
Ralls	Early Harvest
King David	Piedmont
Vandivere	Silver Pippin
American Beauty	Smokehouse
Loudoun	Lawver
Vere	Silver King
Gibbs	Nero
Tompkins King	Salome
Tweeksbury Winter Blush	McAfee
Delaware Red	Commerce
Collins	Baltzley
Arkansas Black	Summer Pippin
Gloria Mundi	Vine
Tolman	Roxbury
Wagener	Lowrie
Ralls	Esopus
Via	Robinson
Pilot	Wealthy
Golden Gate	Yellow Newtown
Buckingham	Oldenburg
Fall Pippin	Kentucky Red
Lady	Ortley
Oliver	Lawver

Altogether eighty-three varieties were reported in old orchards.

t Discussion of Table 1. - Several striking facts are brought out in this table. York easily ranks first as regards both the number of orchards in which it is found and the number of trees planted; this variety constitutes one-third of all the trees reported in the old orchards. York is the great cosmopolitan apple in Virginia; it is found in all the fruit-growing sections of the State. So far as my information goes it does well in all sections, though it is pre-eminent in the Valley region. Its popularity with the growers is indicated by the fact that 46 per cent of the growers who have this variety gave it first rank, and very few growers considered it lower than third in commercial value. The fact that York is adapted to all sections of the State enables this variety to hold first place over varieties, which are unquestionably superior to York in quality.

Winesap is an easy second. This variety is found in 63.20 per cent of the old orchards and comprises 19.93 per cent of the total number of trees in the old orchards. Winesap is more or less limited in its adaptation. It is especially successful in the Piedmont and Blue Ridge regions of the State and in these regions it ranks second only to Albemarle. Winesap usually succeeds wherever Albemarle does; and its range is much greater than that of Albemarle.

The figures in Table 1 show that 34 per cent of the growers who have Winesap in their old orchards place it first in rank and 35 per cent give it second place. This seems to be due to the fact that Winesap and Albemarle are frequently grown in the same orchard on account of the similarity of their environmental requirements and a majority of the growers seem to prefer Albemarle to Winesap. Winesap is held in high esteem by the growers because of its high quality and attractive appearance.

Ben Davis stands third as regards the number of orchards in which it is found, though this variety takes fourth place when it comes to the total number of trees planted. While this variety is very general in its adaption to soil and locality, yet it is not nearly so important a factor in the old orchards of the State as is commonly supposed. From Table 1, it will be seen that Ben Davis comprises 12.56 per cent of the total number of trees in the old orchards. There are approximately three Yorks to one Ben Davis in the bearing orchards which are reported in this paper. Of all the growers who have Ben Davis in their orchards, 16 per cent give it first rank; 31 per cent give it second and 22 per cent place this variety third with respect to its commercial value.

Albemarle ranks fourth as regards the number of or-

chards in which it is found and holds third place in the total number of trees planted. The limitation of this variety to a certain type of soil is frequently mentioned by the fruit growers and this point is discussed under another topic. But where Albemarle can be grown it is held in high esteem and is very popular with the fruit-growers. The growers give this variety high rank; 51 per cent of the growers who have Albemarle in their old orchards, consider it first in commercial importance. Speaking in relative terms, Albemarle ranks higher than any other variety found in the old orchards. It is interesting to note that this variety makes up 15.70 per cent of the total number of trees reported in the old orchards.

Perhaps it is not profitable to go further into the details of Table 1. The reader can glance through the array of facts which are set forth and draw his own conclusions from them. There is a remarkably large number of varieties reported in the bearing orchards. All told, there are eighty--three varieties, several of which I have not been able to find mentioned in pomological literature. However, it may be seen that the main bulk of the plantings in the bearing commercial orchards is composed of just a few varieties. Some of the old orchards which are now still in bearing, date from that period when commercial apple-growing in Virginia

was in the experimental stage. Then the fruit-grower had no way to find out the varieties which were suited to his locality; he did not have the benefit of the "other fellow's" experience, and he was compelled to try out many sorts - if not to his own profit, certainly to the advantage of the apple industry in the State. Later on in the discussion, we shall see that the total number of varieties mentioned in the young orchards has decreased by 36 per cent.

Varieties in Young Orchards. - Under this topic the following question was asked: "Name the varieties in your young orchards (not yet bearing) in the order of their commercial importance, giving the approximate number of each." The young orchards will range in age from one to seven or eight years. One hundred and seventy-four of the fruit growers who replied to my letter have young orchards. The total number of trees reported in the young orchards is 260,124. This number slightly exceeds the aggregate of trees reported in the old orchards. Doubtless the acreage of the young orchards is considerably in excess of that of the old orchards, owing to the fact that trees in the young orchards are generally planted farther apart than trees in the old orchards.

A summary of the answers to the above question is given in Table 2. The explanation of this table is exactly

the same as in case of Table 1, and therefore it need not be repeated here.

Missing Page

The varieties listed below were reported in one orchard each, respectively. As a rule they were reported in small numbers ranging from ten to two hundred and twenty-five. The numbers are included in Table 2 in the item, "Miscellaneous Varieties." These varieties were not inserted individually in the table because their relative rank has no great significance owing to the fact that they are found in so few orchards.

Cannon	Livland Raspberry	Missouri
Kinnaird	Smith	Early Ripe
Summer Rambo		South Carolina Summer
Mother	Wolf River	Nansmond
Lawver	Springdale	Ralls
Gravenstein	America	Oliver
Buckingham	Gilbert	Paradise
Sour Bough	Ingram	Justice

Altogether, fifty-three varieties were reported in the young orchards in this survey.

Discussion of Table 2. - This table presents an interesting array of facts. York stands at the head of the list of varieties in young orchards both as regards the number of orchards in which it is found and also the total number of trees. York is found in 55.75 per cent of the young orchards reported in this survey; and this variety comprises 29.30 per cent of the total number of trees in these orchards. York also maintains its popularity in the young orchards; of the 97 growers who have this variety in their orchards, 54 per cent give it first rank over all other varieties.

This variety is most popular in the young orchards of the Valley region, yet there are extensive plantings of it in the Piedmont region. York is a heavy bearer and a good seller, and therefore the growers find it one of their most profitable varieties.

Stayman holds second place in the list of varieties found in the young orchards as regards both the number of orchards in which it is planted and also the number of trees planted. Stayman is found in 48.85 per cent of the young orchards reported in this survey and comprises 15 per cent of the total number of trees in these orchards. This variety is becoming very important in the Valley region, where it now ranks second only to York. The rapid increase in the popularity of this variety is shown by the fact that its rank has advanced from seventh place in the bearing orchards to second place in the young orchards. The large size, high quality, good flavor and attractive appearance of the fruit especially commend it to both the producer and consumer. It is now found in nearly one-half of the young orchards.

Winesap holds third place in the young orchards as regards both the number of orchards in which it is found and the per cent of the total number of trees. It is found in 37.93 per cent of the young orchards and comprise 13.09

per cent of the total number of trees in these orchards. It will be noticed that Winesap has decreased considerably in distribution and number of trees planted. This may possibly be explained by the fact that Winesap has both soil and climatic limitations. In the Valley region some growers say that Winesap has a tendency to grow too small; but others find it very successful in this region. In the mountain regions at elevations greater than 1500 feet this variety does not seem to do well. In the high plateau section of the upper Valley (Montgomery, Pulaski, Wythe, and Smyth counties) the growers say that Winesap does poorly. However, in the Piedmont region of the State and on the eastern slopes of the Blue Ridge up to an elevation of 1500 feet Winesap is very successful and is considered second only to Albemarle. Winesap is very frequently planted side by side with Albemarle; the former has a much wider range of adaptation than the latter.

Grimes takes fourth place in the young orchards. Grimes is really a fall apple, or possibly might be classified as an early winter apple in this State, and its prominence in the young orchards calls our attention to two points: (1) Fall apples may take an important place in our commercial orchards, and (2) they may be grown profitably as is shown by the successful plantings of this variety in

many sections of the State.*

Arkansas holds fifth place in both the bearing orchards and the young orchards; yet it should be noted that this variety has increased both in the per cent of orchards in which it is found and the per cent which it comprises of the total number of trees planted. This variety is mentioned favorably by growers in many sections of the State.

Delicious, along with Black Ben Davis and King David are comparatively new varieties which have been planted in small quantities by a number of growers. These varieties have been extensively advertised during recent years, and many growers are giving them a trial. They are varieties of promise, especially is this true of Delicious. If Delicious succeeds in this State as it has in some of the western states, and proves to be suited to our environment, it will become an important variety in Virginia orchards within the next decade.

We saw that Albemarle ranked fourth in the bearing orchards; it now holds seventh place in the young orchards.

* Note. - The same statements will, in a measure, apply to summer varieties. In this connection the reader is referred to Gould, H. P., Summer Apples in the Middle Atlantic States, U. S. Department of Agriculture, Bureau of Plant Industry, Bullt. 44. In this bulletin, Professor Gould discusses at length summer varieties and their adaptation to various regions in the middle Atlantic states, giving considerable attention to the fruit-growing sections of Virginia.

But here, as in the bearing orchards, Albemarle is supreme in that limited region to which it is adapted. The esteem in which the growers hold this variety is shown by the fact that 61 per cent of the growers who have this variety in their orchards give it first rank over all others. Relative-ly speaking, this is the highest rank given to any variety in the young orchards. The area in Virginia over which apple orchards are distributed is constantly increasing. Albemarle is peculiarly adapted to a limited area, commonly known as "pippin land". It follows therefore, that the per cent of orchards in which it occurs, and the per cent of the total number of trees of this variety planted will decrease.

We saw that Ben Davis was third in rank in the bearing orchards and now we see that it holds eighth place in the young orchards. Plantings of this variety have decreased markedly. Those who advocate the growing of this variety point out its good qualities as heavy bearer, attractive in appearance and a good seller especially when offered on the southern markets.

Attention should be directed to Rome as a variety which is coming into prominence in sections of the State, particularly Loudoun and Clarke counties. It will be noticed also that summer and fall varieties are coming more into prominence in the young orchards.

Further details of Table 2 need not be entered into in this discussion. The reader can draw his own conclusions from the data presented.

Varieties for Future Planting. - It is important to know what varieties the growers now consider best for planting in their respective localities. In order to obtain opinions from the growers on this point, the following question was asked:

"What varieties of apples would you plant if you were to extend your orchard? State reason for making this choice." From the nature of the case, the safest information on varieties best suited for future planting can be obtained from the growers, many of whom have been in the orchard business for a long time, and have had experience with many varieties. They have had opportunity to observe the behavior of varieties and they can estimate very accurately the commercial value of a variety for their respective localities.

There were two hundred and thirty-one answers to this question. Table 3 gives a concise summary of these answers. This table is made in the same way as those which precede it, and it needs, therefore, no further explanation. This data should be specially valuable to those who contemplate planting apple trees.

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The varieties listed below were mentioned by only one grower each. They were not included in Table 3 since nothing can be said as to their relative rank from the standpoint of the grower.

Mother	Golden Gate
American Beauty	Cannon
Summer Rambo	Rambour Reinette
Rebel	Esopus
Pilot	Golden Russet
McIntosh	Stark
Belmont	Redstreak
Fallawater	Kinnaird
Royal Limbertwig	Rhode Island
Oliver	Smith
Smokehouse	Queen
Shockley	Early Ripe
Livland Raspberry	Maiden Blush
Winter Cheese	

Altogether fifty-one varieties are mentioned as being desirable for future planting.

Discussion of Table 3. - One of the most striking features of this table is the large number of varieties which would be given a prominent place in future plantings. There are at least ten varieties which would be planted rather extensively. This data seems to indicate that a number of varieties are giving satisfaction in different parts of the State. Attention should be called to the reasons which the growers gave for selecting the varieties mentioned in Table 3.

York again easily ranks first. Of the one hundred and twenty-seven growers who would plant this variety, 54

per cent gave it first rank in economic importance. Very few growers place it lower than third in rank. A majority of the growers in the Valley region gave York preference over other varieties. The reasons stated for making this choice are as follows: York is a good bearer; its fruit is of good shipping and keeping quality, and it is a good seller. Several growers stated that York is not a good variety to hold in cold-storage because its skin is tender and has a tendency to blister when taken out of cold-storage.

We found that Stayman Winesap had jumped to second place in the young orchards; it retains this position in the varieties for future planting. Staymen Winesap would be planted extensively in both the Valley and Piedmont regions. The growers favor this variety because it is large in size, high in quality and very attractive in appearance.

Winesap holds third place among the varieties for future planting; 45.45 per cent of the growers would plant this variety, and of the number who would plant it, 50 per cent give it first rank in economic importance. The growers would plant this variety on account of its high quality. It is also a ready seller and is held in high esteem on the markets. There is a tendency for the fruits to grow too small unless the variety is planted in an environment to which it is adapted.

Arkansas would be planted extensively in the future orchards. This variety has several points which recommend it to the growers. It is of good size and good quality, and it is a showy apple. Some growers have complained that it is a shy bearer, but this objection is not shared by many of the growers.

Grimes is the most prominent apple of the fall or early winter class. Its peculiarly rich flavor and ready sale on the market recommend it to the growers.

Albemarle holds sixth place, due to the fact that it is adapted to a limited region. But in its own region it is held in the highest esteem. This is shown by the fact that 56 per cent of the men who would plant this variety give it first rank in economic importance, which is the highest individual rating of any variety suggested for future plantings.

It is unnecessary to mention other varieties. Table 3 shows how the growers feel regarding the relative value of varieties for future plantings.

Comparison of Varieties. - In order that the reader may get at a glance the relative rank of varieties, I have made in Table 4 a comparison between ten leading varieties in bearing orchards, young and prospective orchards. This table gives a bird's-eye view of the status of varieties in

the commercial orchards. It shows the trend of plantings and it is a fairly safe index to the adaptation of varieties to the State. It gives the growers' opinion based upon their experience with varieties. The table is made up from the preceding tables with the addition under "Young Orchards" and "Prospective Orchards" of columns which show whether there has been an increase or decrease in plantings over the old orchards.

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Discussion of Table 4. - York holds first place all along the line as regards both the number of orchards in which it is found and the per cent of trees which it comprises of the total plantings. Winesap has shifted from second place in the old orchards to third place in both the young and prospective orchards. Ben Davis has changed from third place in the bearing orchards to eighth place in the young orchards and ninth place in the prospective orchards. Another remarkable shift of position is noted in the case of Stayman Winesap. As regards the number of orchards in which it is grown, this variety was seventh in the old orchards, but it has jumped to second place in both the young and prospective orchards. And the increase in the percent which this variety constitutes of the total number of trees is also very noticeable. Delicious and Black Ben Davis had low rank in the bearing orchards, but have come to positions of importance in the young and prospective orchards.

How Many Varieties should the Grower Plant? - This is often a difficult point to settle. There seems to be a tendency for those who are beginning the orchard business to plant too many varieties. In order to get the opinion of growers on this point the following question was asked: "How many varieties do you think it profitable to grow?"

One hundred and eighty growers answered this question

directly. The average of their answers is four. Some said "the fewer the better", "not many", "few", etc. The answers on the whole show clearly that the successful growers realize the importance of not planting too many varieties. The growers who have large orchards usually want enough trees of each variety to enable them to market that variety in car-load lots, rather than to be forced to ship in mixed car-load lots. Therefore the ^{smaller?} larger one's orchard the greater may be the number of varieties planted.

Again, different varieties sometimes require different methods of treatment; especially does this apply to the operations of spraying. Therefore, it sometimes becomes difficult to handle an orchard to the best advantage when the varieties are very much mixed.

There is an important advantage to be derived from mixed planting which should not be overlooked in this connection. It is a recognized fact that certain varieties under certain conditions will not set fruit when planted alone in large blocks. Some varieties are self-sterile, that is, the pistil of the flower will not become fertilized by pollen from this flower or other flowers of this variety. The causes which influence self-sterility are not understood. A number of valuable experiments have been

made with the object in view of solving this problem.* It has been shown that many varieties, even though they may not be self-sterile, will set fruit better and produce better apples when the pollen from another variety fertilizes the variety in question. Winesap sometimes sets fruit when pollinated with its own pollen; again, instances are known where large blocks of Winesap trees are barren, presumably, because they are self-sterile, and no other varieties are near enough to furnish pollen. For these reasons it seems advisable for the growers to plant two or more varieties.

Fewer Varieties being Planted. - In order to obtain information on this point the following question was asked: "Are growers using fewer or more varieties than formerly?"

Answers to this question are grouped below:

*Note. In this connection the reader will do well to consult the work of the following authors:
Waite, M. B., Self-sterility in Orchard Fruits. U. S. department of Agriculture, Div. of Veg. Path. Bulletin 5.
Pollination of Pernaceous Fruits. Yearbook U. S. Dept. Agr. for 1898, pp. 167-180.
Fletcher, S. W., Pollination in Orchards, Cornell University Agr. Exp. Sta. Bulletin 181, 1900.
Pollination of Bartlett and Kieffer Pears. Annual Rep. Virginia Agr. Exp. Sta. 1909 and 1910, pp. 213-224.
Lewis, C. I. and C. C. Vincent, Pollination of the Apple. Oregon Agrl. Exp. Sta. Bulletin 104: pp. 40. 1909.

Relative to No. of Varieties being planted	No. of growers so reporting.
Fewer	136
More	44
No. Noticeable change	11

From this it may be seen that there is a clear tendency to use fewer varieties. In many communities the growers have found out from experience what varieties are best adapted to the locality, and all others are becoming eliminated rapidly from the plantings. There is a tendency in some places to plant more varieties only in the sense that growers are testing out new varieties, but this is usually done on a small scale. The commercial growers are confining their attention to the standard varieties.

Some Causes Which Determine the Adaptation of Varieties. - In order to obtain more detailed information regarding the adaptation of varieties to certain localities, and to find out what environmental factors are most important in the adaptation of varieties, the following question was asked: "Does climate or any other factor, as elevation, soil, insects or diseases peculiar to your locality limit you to certain varieties?"

A majority of the growers agreed that the factors, soil and climate have a very marked influence on varieties and that the varieties to be planted in a given locality are limited, in a measure, by the local environment. A number

of growers were of the opinion that there were no limiting factors in their respective localities; it is entirely possible that these growers based their choice of varieties in the first instance on the experience of the community in which they began the business, and therefore they had not observed any unfavorable influence of the environment, for they made the right choice to begin with. It sometimes happens that a variety is reported very successful by one man, while his neighbor on an adjoining farm may find the same variety worthless. This shows that the influence of the environment is very clearly marked. Furthermore, it emphasises the importance of having all available information regarding the adaptation of a given variety before planting that variety on a large scale. The difference between success and failure may depend upon the grower's knowledge of the requirements of the variety which he plants.

The question of acclimatization may well be considered here. A number of growers stated that certain varieties which are prominent in the commercial orchards of the North become fall apples when brought south. This point is illustrated by Baldwin, Northern Spy, Mother and Possibly Jonathan. This is the ecological response of the variety to its environment.

The growers have a tendency to ascribe the limitat-

ions on a variety to some one factor, as, for example, soil; when as a matter of fact it may be due to a number of causes. In general, we may say that there are four primary factors, which affect the geographical distribution of varieties, namely, temperature, moisture, soil, and parasites (including insects and diseases). Many other secondary factors may come into play; but they are essentially related to the four factors mentioned above. Exposure, meaning the lay of the land with respect to the points of the compass, and elevation are important factors in the adaptation of varieties. Exposure may be important in securing protection from wind or in allowing the fruit to take on a high color.

The human element, or the "personal equation" should not be lost sight of when we begin to count up the causes why varieties may succeed or fail. The grower himself is an important factor. One man writing from the Valley region emphasized this point when he said: "With good care and cultivation nothing hinders results; I have had six crops in succession."

The limitations of the variety, Albemarle, are well known and often remarked upon. This variety requires good elevation (1000 feet); generally it does not succeed at an elevation of 500 feet. It delights in a deep rich, friable soil; Porters black loam, which is a black soil, commonly

spoken of as "pippin land", seems to be the most suitable soil for the variety. This variety does well where the proper soil and elevation are found in the Piedmont and Blue Ridge regions of the State. The coves in the eastern slopes of the Blue Ridge Mountains furnish admirable environment for this variety. It does not succeed in the Valley region, nor has it proved successful on the Appalachian plateau or southwest Virginia. Albemarle is susceptible to fungous troubles (particularly bitter rot). The same objection applies in a general way to other varieties having light-colored or yellow skin.

York is a cosmopolitan variety, especially adapted to the Valley region of the State. In the lower part of the Valley, York is severely attacked by cedar rust and several growers stated that plantings of this variety would be reduced in the future on this account. York does well on the clay loams. One grower finds that there is not enough lime in the soil of the Piedmont region to grow York to perfection. It does not seem to color as well in the Piedmont region as it does in the Valley. York is well adapted to the Alleghany Plateau in south-west Virginia.

Winesap is well adapted to the clay loams of the Piedmont region ranging up the mountains to an elevation of 1000 feet. It does not succeed at high elevations. On the

Alleghany Plateau the fruits of this variety are small and poor in quality. Its fruits are frequently too small in the Valley region. Many growers pointed out the fact that Winesap is very susceptible to scab.

Grimes is well adapted to the Valley and Piedmont regions of the State. Many growers spoke of the collar rot which affects this variety, causing it to be a short-lived tree. On account of its short life, some growers recommend that trees of this variety be planted as fillers. The collar rot is a disease which attacks the trunk of the tree near the ground at the point of union between the stock and cion. Now this difficulty may be avoided by whip-grafting or budding at some distance above the ground. If this precaution is followed, the objection to this variety mentioned by several growers may be dispensed with.

Limitations of other varieties were merely mentioned by the growers but not discussed at length. Ben Davis is a sure bearer in the Piedmont region, and grows to perfection in the Valley region. Stayman Winesap is especially adapted to the Valley region. Some growers reported Arkansas as very successful, while others considered it a shy bearer. One grower in the Valley region stated that Cannon Pearmain is frost proof in the Valley.

Scale Resistance. - It has been observed that some varieties of apples resist the attacks of San Jose scale quite

markedly; while other varieties are attacked much more severely by this insect. The cause of this difference is not known; nor is there any definite information on the extent of immunity and susceptibility among varieties. In order to find out whether the growers had observed differences in the resistance of varieties, the following question was asked: "What varieties resist scale most successfully"?

Naturally it will be difficult to get consistent replies to this question, for the growers have only a few varieties for comparison. And this comparison must be based on the few varieties which the individual growers have, which comparison might or might not hold true for varieties in general. A large number of growers had seen no difference in the capacity of varieties to resist scale, but considered all varieties alike in this regard. One man said that "Lime-Sulphur" is the most resistant variety. Table 5 gives a summary of the replies of the growers who had a positive opinion on the question.

Table 5. Scale Resistant Varieties.

Variety	Number of growers who considered it so.
York	42
Winesap	26
Albemarle	13
Stayman Winesap	8
Arkansas	8
Ben Davis	6
Rome	4
Jonathan	3

Royal Limbertwig	2
Baldwin	2
Grimes	1
Bonum	1
Queen	1
Virginia Beauty	1
Cannon	1
Ralls	1
Red Astrachan	1
Wagener	1

Susceptibility to Scale. - The following question was asked: "What varieties are most susceptible to scale?" Among those who answered this question, sixteen growers had observed no difference, six did not know, one thought sweet varieties more susceptible, another thought acid varieties more susceptible, and still another considered fall and summer varieties to be attacked most quickly by San Jose scale.

Table 6 gives a summary of the replies made to this question.

Table 6. Varieties Susceptible to Scale.

Variety	Number of growers who considered it so.
Ben Davis	69
Winesap	15
Albemarle	15
York	11
Grimes	4
Arkansas	4
Baldwin	2
Northwestern Greening	2
Fall Cheese	2
Missouri	1
Nansemond	1
Jonathan	1
Royal Limbertwig	1
Gano	1
Winter Paradise	1
Smokehouse	1
Black Ben Davis	1

By comparing tables 5 and 6, it may be seen that the replies are not entirely consistant. A variety may be considered resistant by one grower and susceptible by another. There seems to be a decided agreement of opinion among the growers regarding the susceptibility of Ben Davis and its allies.

Disease Resistance. - "What varieties resist disease most successfully?" This question was asked to find out to what extent disease immunity and resistance are prevalent among varieties. Naturally one could not expect very definite answers to this question. It is also very largely a matter of comparison. Of course the growers were able to compare only those varieties which they had in their orchards, , and in any correct interpretation of their answers this point must be taken into consideration. A number of growers stated that they had observed no difference in varieties with respect to disease resistance. Some growers noted that certain varieties are comparatively free from disease, but may be attacked by some particular disease. For example, York is a very clean, healthy apple, but it is attacked in some localities by cedar rust. Likewise, Winesap is very healthy excepting its susceptibility to scab. Table 7 gives a summary of the replies which the growers made to the above question.

Table 7. Disease Resistant Varieties.

Variety	Number of growers who considered it so.
York	51
Winesap	44
Ben Davis	19
Arkansas	18
Stayman Winesap	14
Bonum	9
Albemarle	7
Grimes	6
Rome	4
Royal Limbertwig	4
Delicious	4
Black Ben Davis	3
Robinson	2
Shockley	2
Baldwin	3
Northern Spy	1
Roxbury	1
York Stripe	1
Fall Cheese	1
Jonathan	1
Yellow Transparent	1
Queen	1
Ingram	1
Nero	1
Gibbs	1
Delaware Red	1
Lowrie	1
Summer Rambo	1
Cannon	1
Stark	1
Virginia Beauty	1
Smokehouse	1
Wealthy	1

Susceptibility to Disease. - In order to bring out the point of difference in varieties with respect to their susceptibility to disease the following question was asked; "What varieties are most susceptible to disease?" Some growers stated that they had noticed no difference in variet-

ies in this regard. Others had very positive opinions on the question. Several growers stated that summer varieties suffered more from fungous diseases than winter varieties. The answers to this question are tabulated in Table 8.

Table 8. Varieties Considered Susceptible to Disease.

Variety	Number of growers reporting it so.
Albemarle	44
York	38
Ben Davis	34
Winesap	30
Grimes	12
Fallawater	5
Rome	5
Early Harvest	3
Kentucky Red	3
Fall Pippin	3
Smith	3
Wealthy	2
Pilot	2
Jonathan	2
Arkansas	2
Baldwin	2
Smokehouse	2
Delaware Red	2
Missouri	2
Rambo	1
Strawberry	1
Arkansas Black	1
Lawver	1
American Beauty	1
Northern Spy	1
Rhode Island	1
Paradise	1
Yellow Transparent	1
Domine	1

It is not possible to draw definite conclusions from the data presented in the above table, yet certain tendencies are clearly indicated. Many growers stated that York is

susceptible to cedar rust; otherwise it is comparatively free from disease. The most frequent disease of Winesap is scab. Albemarle is susceptible to Bitter Rot; this point was noted by many growers. Grimes is attacked by collar rot. Bitter rot is the most common disease of Ben Davis. Stayman Winesap is not mentioned by any grower as being susceptible to disease.

A comparison of Tables 7 and 8 brings out the fact that many of the varieties mentioned as disease resistant in the former are catalogued as susceptible to disease in the latter. The point which I mentioned in discussing the data in Table 7 applies here also; the answers were comparative and of course the growers could make the comparison only between such varieties as they were growing. Since a few varieties constitute the bulk of the plantings in the commercial orchards, we would naturally expect the comparison to be drawn between these varieties.

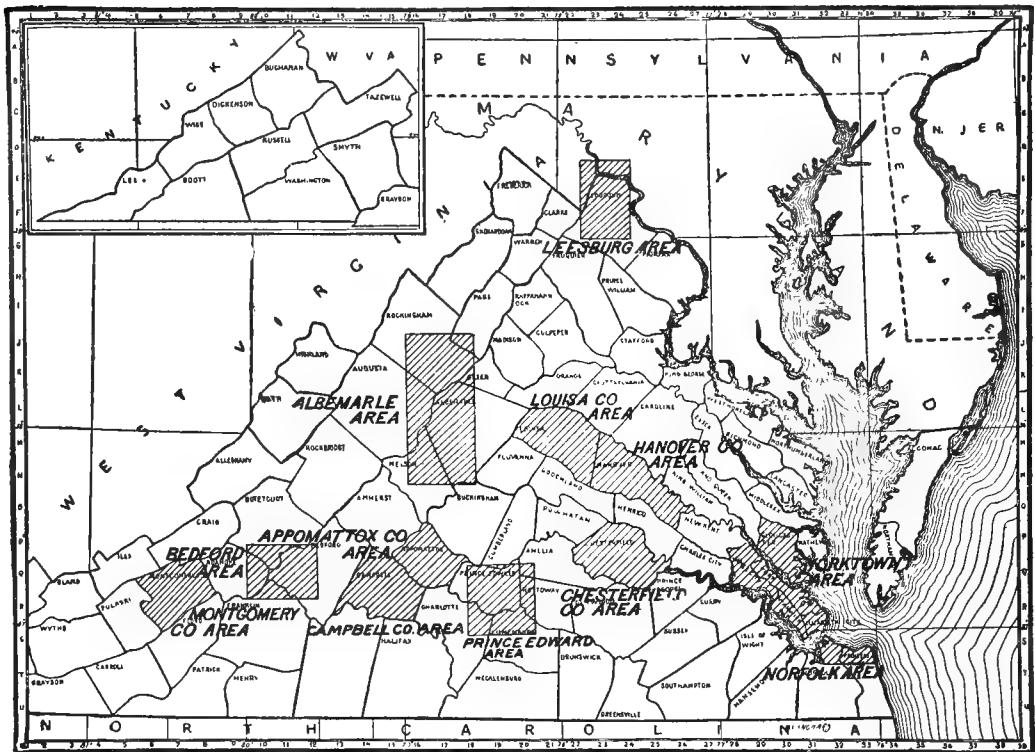


Fig. 3. Sketch map showing the location of areas of which soil surveys have been made. (after Winston, U. S. Dept. Agr. Bureau of Soils).

SOILS AND VARIETIES OF APPLES.

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Data on Fruit Soils. - The following question was asked: "Give a brief description of the soil in your orchard; state whether sandy, sandy loam, clay loam, heavy clay, light clay, color, etc., and state character of the subsoil."

From the answers received to this question I was able in most cases to identify the soil type from the descriptions given by keeping in mind the location of the orchard and comparing the growers' descriptions with the technical descriptions of soil types given in the soil surveys.

Soil surveys have been made in several counties in the State. (See Fig. 3). The information regarding soil types herein discussed was obtained from the surveys made by the Bureau of Soils of the United States Department of Agriculture. I asked the fruit growers to give a brief description of the soil on which their orchards were planted. In some cases, where the orchards were located in an area which had been surveyed, it was easy to determine the type of soil; in other cases where the orchards were located in areas which had not been surveyed it was more difficult to determine the type of soil from the grower's description. I have made an attempt to correlate varieties of apples with the different types of soil. The data at hand is not sufficient to warrant definite conclusions.

Soils of the Piedmont Region.

The topography of this region is that of a broad, rolling plain that has been cut by numerous streams. The altitude varies from 500 feet to more than 1000 feet above sea level.

The soils of this region are purely residual in origin and have been derived almost exclusively from the weathering of igneous and metamorphic rocks and the principal soil types are included in the Cecil series. However, there are some sandstone and shale areas. The principal soil types formed from the sand stones and shales are included in the Penn series.

Cecil Series. - The Cecil series includes the most important and widely distributed soils in the Piedmont region. The heavier members are known as "red-clay lands" and are characterized by red-clay subsoils, with gray to red soils ranging in texture from sand to clay, the lighter colors prevailing with the sandy members of the series. The subsoil is characterized by a sharp quartz sand, which is always scattered through it, and occasional veins of quartz or flint rock. These soil types are residual in origin, being derived from the degredation of igneous and metamorphic rocks. Outcrops of the parent rock are rare; however fragments and boulders are found on the surface in varying quanti-

ties.

Cecil Clay is sometimes spoken of as "red land" and sometimes as "chocolate land", depending upon the color of the soil. The soil of the Cecil clay varies from a brown to a reddish or dark brown loam or clay loam, averaging about 8 inches in depth. The subsoil is a dark red clay loam, grading into stiff, tenacious red clay, 36 inches or more in depth. Quartz sand and fragments are present in both the soil and the subsoil, and angular fragments are found upon the surface; these fragments often form as much as 60 per cent of the surface. The wide extent and distribution of Cecil clay is shown by the following table, compiled from the soil surveys referred to above.

	Area of Cecil Clay	Proportion- al extent
Albemarle area, Harrisonburg Sheet	1,344	
" " Waynesboro "	24,704	8.8
" " Buckingham "	53,632	
Bedford Area	142,730	35.3
Leesburg "	32,000	11.9
Campbell "	23,680	6.7

Other areas in the Piedmont region where fruit is not grown also show considerable bodies of this type of soil.

The adaptation of varieties may be shown to some extent by noting the order in which varieties were reported on the Cecil clay type of soil, and the number of growers reporting them.

Variety	Number of growers reporting it.
Winesap	40
York	27
Ben Davis	22
Stayman Winesap	13
Arkansas	13
Albemarle	11
Rome	9
Grimes	7
Bonum	5
Jonathan	3

It seemed to be the general opinion of the growers that most varieties of red apples succeed well on this heavy type of soil. However, both Grimes and Albemarle are grown to a limited extent on Cecil clay. Grapes do well on the Green Mountain area which is composed of Cecil clay. The more loamy areas having an eastern exposure are best suited to vineyards. The soil is generally too heavy for peaches.

Cecil loam varies greatly in color, yellowish, light or dark brown, reddish-brown or red color is met with in different localities. The depth of the surface soil varies from 6 to 12 inches, with an average depth of 10 inches. There is usually some fine sand in the soil, which is occasionally great enough to give the soil a somewhat sandy character. The subsoil also varies in color and texture. There are two principal phases. The typical one is yellowish, occasionally slightly reddish, loam, grading into the rotten rock (a mica schist) at a depth generally less than 36 inches.

The heavier phase of Cecil loam, occurring on the uplands and more gentle slopes consists of a loam to clay loam, and it usually becomes more micaceous and lighter with depth. The soil and subsoil contain a large quantity of finely divided mica, giving it a soft and greasy feel.

Cecil loam is a piedmont soil. The typical Cecil loam is of residual origin, being derived from the weathering of mica schists. The distribution and extent of this soil type is indicated by the following data:

	Area of Cecil Loam Acres	Proportionate extent per cent
Albemarle Area, Waynesboro Sheet	39,104	10.5
" " Buckingham "	55,488	
Leesburg Area	89,600	33.4

Cecil loam is well adapted to apples and pears and there are successful commercial peach orchards on this type of soil. When this soil extends up the slopes of the foothills it is well adapted to fruit. The red varieties of apples, such as Winesaps, Ben Davis, Rome, Stayman Winesap and others. Grimes also does well. Peaches are grown on the lighter phases of this soil.

Cecil sandy loam is locally called "gray land". This is a gray, yellow, or light brown sandy loam with an average depth of 12 to 14 inches. It is underlain by a yellow sandy loam passing through a red clay loam into stiff red clay. In some localities the sandy surface soil immediate-

ly overlies the stiff, red clay subsoil. Both the soil and the subsoil carry fragments of quartz and these fragments appear also on the surface.

Cecil sandy loam is a residual soil derived from the weathering of granites and other igneous and metamorphic rocks. This soil generally occurs in small irregular and broken areas. It is found on the level uplands, and slopes of the rolling plateau, and it extends up the mountain slopes to an elevation rarely exceeding 800 feet. The distribution of Cecil sandy loam is given below.

	Area of Cecil Sandy Loam Acres	Proportional extent per cent
Albemarle Area, Harrisonburg Sheet	3,944	
" " Waynesboro	38,912	5.2
" " Buckingham	5,952	
Bedford "	33,740	8.3

Other regions not adapted to fruit growing also have this type of soil. Cecil sandy loam is considered thin or poor; however it responds readily to improvement. The following table shows the order in which varieties are planted on this soil.

Variety	No. of growers reporting it
Winesap	8
York	5
Stayman Winesap	4
Arkansas	4
Ben Davis	3
Bonum	2
Albemarle	2

Cecil sandy loam is well adapted to peaches and small fruits. On the higher slopes pears also do well.

Cecil clay loam is a reddish yellow or light brown heavy loam with an average depth of 10 inches. The subsoil consists of reddish-yellow or light brown heavy loam grading into clay loam at an average depth of 30 inches. From 10 to 30 per cent of stones and boulders, principally syenite, are commonly present in both soil and sub-soil. The surface is moderately to steeply rolling, with occasional small level areas. The soil is residual being derived chiefly from syenite, but in small local areas, other metamorphic rocks have entered into its formation.

Cecil clay loam is not mapped in the areas which have been surveyed in Virginia. However, a number of growers in the Piedmont region described such a clay loam in their replies to my question. The data which follows shows the adaptation of varieties to Cecil clay loam.

Variety	No. of growers reporting it.
York	12
Winesap	9
Ben Davis	7
Grimes	5
Arkansas	4
Stayman Winesap	3
Black Ben Davis	3
Rome	2
Bonum	2
Jonathan	2
Albemarle	2

Cecil stony loam varies from brown sandy loam to brown or red loam with an average depth of 8 inches, beneath which is a red clay loam or clay. From 30 to 60 per cent of the soil and subsoil is composed of stones and boulders. This is a residual soil derived from the weathering of intrusive dikes of trap rock, and in part also from other igneous or metamorphic rocks. The surface is usually hilly and broken.

This type of soil is not mapped in the soil surveys of the State, though several growers have orchards on this type of land. The soil is adapted to apples. York, Ben Davis and Winesap do well on Cecil stony loam.

Penn. Series. The Penn series consists of Indian or purplish red soils derived from the weathering of red sandstones and shales of Triassic age. Detached areas of Triassic rock occur in shallow basins.

Members of this series have been mapped in the Albemarle area, the Lessbury area and the Campbell area. I shall not give detailed descriptions of these soils. As yet there are few orchards grown on these types of soil, though several numbers of the series are well adapted to fruit.

Penn loam is a dark Indian-red loam from 8 to 12 inches deep, underlain by an Indian-red clay loam. This peculiar color is distinctive of the formation wherever found and

the type is easily recognized. The soil is known locally as "red-rock land", on account of the numerous small red sandstone fragments which occur in the soil, and subsoil in quantities varying from 5 to 20 per cent. The surface is gently rolling. The following data shows the extent of this soil type.

	Area of Penn loam	Proportional extent per cent.
Leesburg Area	18,880	7.0
Campbell "	5,696	1.6

I have not obtained sufficient data to determine the correlation between this type of soil and varieties of apples. However, it seems clear that apples will succeed on Penn loam.

Penn Clay consists of from 6 to 12 inches of a red or reddish brown loam, resting upon a sub-soil of heavy red clay. Both the soil and subsoil have the Indian-red color characteristic of the Triassic red sandstone from which the soil is in part derived. From 1 to 10 per cent of the soil mass is composed of small sandstone fragments. In other areas of this type numerous limestone conglomerate boulders cover from 10 to 25 per cent of the surface. This soil type bears a close relationship to the Hagerstown series found in the Valley region. The extent of this soil type is shown by the figures which follow.

	Area of Penn Clay Acres	Proportional extent per cent
Leesburg area	11,776	4.3
Albemarle " Buckingham Sheet	16,128	1.8

Some small orchards are found upon Penn clay. Apples do well upon this type of soil.

Penn stony loam consists of a rather heavy Indian-red loam, 8 to 10 inches deep, containing from 30 to 60 per cent of red or brown sandstone fragments. The subsoil is of much the same character, though it is a heavier red loam. There are 1280 acres of this soil mapped in the Leesburg area, which is 1/2 per cent of the area.

This type of soil is well adapted to orcharding. Apples do well upon it.

Miscellaneous Piedmont Soils.

Loudoun Sandy loam consists of 8 to 12 inches of a heavy brown or gray sandy loam, underlain by a heavy yellow or red loam or clay loam. Often the subsoil contains a quantity of coarse sand, making the texture much the same as that of the soil. The sand is composed of coarse rounded and sub-angular quartz particles. Occasionally the surface is covered with 5 to 20 per cent of angular quartz fragments. The topography of this soil varies from rolling to hilly and ridgy. It is well drained. In the Leesburg area, 27,968 acres of

this soil have been mapped, which makes up 10.4 per cent of this area.

Peaches do especially well on the more elevated phases of this soil. Apples also succeed well. Rome, Winesap, York, Ben Davis, Grimes and Arkansas were reported as doing well on Loudoun sandy loam.

Iredell clay loam is a dark brown loam about 8 inches deep, containing small rounded iron concretions on the surface. The subsoil is a stiff impervious yellow clay, underlain by soft decomposed rock. It is locally known as "wax land" or "blackjack land". The distribution of this type of soil is shown by the following data.

	Area of this soil type	Acres	Proportional extent per cent
Leesburg area		18,048	6.7
Campbell "		1,344	.4

Where the soil is elevated and well drained, apples succeed fairly well upon it.

Soils of the Mountains.

The parallel ranges of the Appalachian Mountains extend across the state from northeast to southwest. The altitude of the mountain regions ranges from 1000 to about 4000 feet. The rocks of the Blue Ridge Mountains, or the eastern range, are igneous and metamorphic in origin. The rocks of the Alleghany Mountains, or western range, and Alleghany

Plateaus are sedimentary. Thus we have different series of soils in different parts of the mountains and plateaus. The igneous and metamorphic rocks give rise to soils of the Porters series; while the Dekalb series is formed from the weathering of sandstones and shales of sedimentary origin.

Porters Series. - The Porters series includes the residual soils of the Appalachian mountains derived from igneous and metamorphic rocks. These soils are quite similar to those of the Cecil series, but are classed separately on account of the difference in topographic position. Some members of the Porters series are eminently adapted to fruit culture.

Porters sand is a mountain soil. It consists of a gray or yellowish sand averaging 8 inches in depth, underlain by a coarse yellowish sand that runs into the disintegrated rock at depths usually less than 36 inches. Rock fragments are present in both the soil and subsoil and huge boulders are scattered upon the surface. This soil is derived through the weathering of granite, gneiss and similar rocks. This soil is of rather general occurrence in the mountains.

	Area of Porters sand	Proportionate extent per cent
	Acres	
Albemarle Area, Harrisonburg Sheet	12,800	
" " Waynesboro	25,472	12.6
" " Buckingham	76,864	

The smoother and less stony slopes of this soil are well adopted to fruit growing. Many orchards have come into bearing on this soil. Peaches do well, the most successful varieties being Elberta and Bilyeu. Slopes with an elevation of 1000 to 1500 feet are best for peaches. Apples do well on this soil. The following varieties are reported: Albemarle, Winesap, Ben Davis, Arkansas, Bonum and Grimes. This soil produces apples of fine quality. Porters sand needs to be fertilized in order to keep the orchards in good condition.

Porters sandy loam is found upon the tops and slopes of the mountains. The soil varies from a gray sand to a yellowish gray sandy loam about 10 inches in depth. The sub-soil is yellowish sand, sometimes a reddish sand, the sand becoming coarser at lower depths. Rock fragments are found in both the soil and the subsoil. Rocks and boulders are found upon the surface also. There are 46,150 acres of this soil in the Bedford area and it comprises 11.4 per cent of this area. Porters sandy loam is well adapted to peaches and grapes. Apples do well on this soil. Some idea of the adaptation of varieties of apples to this type of soil may be had from the following data.

Variety	No. of growers who reported it.
Winesap	14
Albemarle	12
York	12
Bonum	5
Grimes	4
Ben Davis	4
Stayman Winesap	3
Arkansas	2
Rome	2

All these varieties were reported satisfactory. It is probable that Porters sandy loam occurs outside of the Bedford area.

Porters black loam is a loose, mellow, dark-brown to jet-black loam, averaging about 12 inches in depth. The subsoil is a loam of slightly heavier texture and of a light-brown to yellowish color. The depth of the subsoil ranges from 36 inches on the tops and slopes of the mountains to many feet in depth in the coves. The color of the soil is due in some measure to the presence of comparatively large proportions of organic matter. This forest mold also probably accounts for the mellowness of the soil. Frequently rock fragments are found on the surface and in both the soil and subsoil to the amount of about 20 per cent. Porters black loam is a residual soil derived from granite, gneiss and schist. Locally Porters black loam is called "pippin land" or "black land". It is found in the mountain coves, on the slopes and mountain tops at elevations greater than 800 feet.

Porters black loam is known to occur in counties, practically all of the counties in the Blue Ridge region of the state. The data which follows shows its distribution in the areas where soil surveys have been made.

	Area of Porters black loam	Acres	Proportionate extent per cent
Albemarle area, Harrisonburg sheet		18,112	
" " Waynesboro	"	21,888	7.6
" " Buckingham	"	28,736	
Bedford area		8,270	2.0

Porters black loam is an excellent fruit soil. Peaches succeed well upon it, Bilyeu which is adapted to the mountain region does very well on this type of soil. The data given below was obtained from the fruit growers and it shows the varieties of apples which are being grown upon this soil.

Variety	No. of growers reporting it on this soil
Albemarle	37
Winesap	23
York	19
Arkansas	8
Ben Davis	7
Grimes	6
Bonum	5
Stayman Winesap	4
Rome	4

Albemarle and Winesap are preeminently adapted to Porters black loam and these two varieties are perhaps the most profitable to grow upon this soil. Many growers mentioned the fact that Albemarle is limited to this soil type and perhaps a few other members of this series.

Porters clay loam is not mapped in any of the areas

of which soil surveys are available. However the growers described a clay loam of this series lying between Porters loam and Porters clay.

Varieties reported on this soil type are Albemarle, Winesap, York, Arkansas and Ben Davis.

Porters clay consists of from 6 to 12 inches of a brown or reddish-brown loam, underlain by a heavy red loam, or stiff tenacious red clay. It is a rough mountain land, and is usually very stony having from 15 to 60 per cent of small and large schist fragments on the surface. It is found in small areas on the mountain slopes between 1000 and 2000 feet elevation. This soil is often spoken of as "mountain red land". The distribution of this soil type in the surveyed areas is given below.

		Area of Porters clay	Proportional extent per cent
		Acres	
Albemarle Area, Harrisonburg	Sheet	10,944	
" " Waynesboro	"	16,000	3.6
" " Buckingham	"	5,568	
Leesburg area		2,752	1.0
Bedford area		28,240	7.0

Porters Clay has proved to be a good fruit soil. The more elevated parts of this soil approach very closely Porters black loam and in such localities apples do especially well. The data which follows shows the correlation between varieties and this soil type.

Variety	No. of growers reporting it.
Winesap	13
Albemarle	12
York	11
Ben Davis	9
Stayman Winesap	5
Arkansas	3
Grimes	2
Bonum	1
Esopus	1

Dekalb Series. - The Dekalb series is derived from the disintegration of sandstones and shales, from Silurian to Carboniferous in age. The surface soils are gray to brown in color, while the subsoils are commonly some shade of yellow. The surface features consist of gently rolling table-lands, hills and mountains. The stony and sandy members of this series are well adapted to orchard fruits.

Dekalb stony loam was mapped as Edgemont stony loam in the earlier surveys. The soil is a gray to yellowish sandy loam from 6 to 10 inches deep, grading into a subsoil of slightly heavier texture and yellower color. In some cases the subsoil approaches a true clay. Both soil and subsoil contain a great quantity of sandstone, conglomerate and sandy calcareous shale fragments. The topography is rough and broken. The distribution of this soil type in the areas surveyed is given below.

		Area of Dekalb stony loam	Proportional Acres	extent per cent
Albemarle area,	Harrisonburg Sheet	75,136		
" " Waynesboro	"	50,048	14.9	
" " Buckingham	"	9,472		
Leesburg area		19,072	7.1	
Montogmery area		31,872	12.7	

From these figures it may be seen that this soil type is rather extensive. With proper elevation and exposure, the sandy and sandy loam phases are well adapted to peaches. Apples are also grown upon Dekalb stony loam successfully. Rome, Grimes, Stayman Winesap and York are the varieties mentioned on this soil. Data is not sufficient to show the adaptation of varieties of apples to this soil.

Dekalb sandy loam is not mapped in any of the areas surveyed in the State. The soil consists of a gray to brown sandy loam of medium to fine texture from 9 to 12 inches deep, underlain by yellowish-brown, slightly sticky sandy-loam. It is a residual soil derived from sandstone rock.

This soil is very well adapted to apples and peaches.

Soils of the Valley Region.

The soils of the Valley are essentially limestone. The limestone soils are residual in origin being derived from the weathering in place of limestone of differing age and composition. These soils constitute but a small percentage of the original rock, the larger part having gone into solution. The most important soils in the Valley region are em-

braced in the Hagerstown series.

Hagerstown Series. - The Hagerstown series is formed mainly from the solution and subsequent filtration of pure massive limestone of Cambro-Silurian age. These soils, as a rule, occur in valleys bordered by areas of more resistant sandstones and shales.

Hagerstown stony loam to an average depth of 8 inches, consists of silty or fine sandy loam usually brown in color, but varying from light gray to yellowish. The subsoil consists of a yellow or yellowish red clay loam grading at an average depth of 24 inches into a stiff red clay which extends to unknown depths. On the surface, and in the soil and first few inches of the subsoil occurs a high percentage of angular chert fragments. This type of soil is residual and is derived from the solution of impure limestone containing cherty layers, the insoluble material being concentrated on the surface. Hagerstown stony loam occupies high ridges in the limestone valleys.

The distribution of this soil type in the areas where soil surveys have been made is shown from the data given below.

	Area of Hagerstown stony loam	Acres	Proportional extent per cent
Albemarle area, Harrisonburg Sheet	47,552		
" " Waynesboro "	11,584	6.5	
Bedford area	11,950	3.0	
Montgomery area	29,888	11.9	

There are a large number of commercial orchards on this type of soil. Peach orchards have given very good results on this soil. The data which follows gives some idea of the adaptation of varieties of apples to Hagerstown stony loam.

Variety	No. of growers reporting it.
York	19
Stayman Winesap	12
Winesap	10
Ben Davis	10
Arkansas	6
Grimes	7
Black Ben Davis	4
Rome	2
Jonathan	1

Hagerstown stony loam is generally regarded as thin land. But with proper care and some fertilization it produces excellent fruit.

Hagerstown stony clay consists of about 8 inches of brown to yellow clay loam or clay, underlain by sticky clay. Usually limestone fragments are abundant in both the soil and subsoil. This soil type does not occur in any of the areas which have been surveyed.

The following varieties of apples are reported on this soil type: York, Stayman Winesap, Arkansas, Winesap, Black Ben Davis, and Ben Davis.

Hagerstown sandy loam is a fine sandy loam about 12 inches deep, of a gray to yellowish or light brown color.

The subsoil is a yellowish-red clay grading into a stiff red clay. The type occupies some of the higher ridges of the valleys and has good drainage. It is of residual and colluvial origin, being derived from limestone. The occurrence of this soil type is shown by the figures given below.

	Area of Hagerstown Sandy loam	Acres.	Proportional extent per cent
Albemarle area, Harrisonburg Sheet	35,520)		
" " Waynesboro "	9,984)		5.0
Bedford area	11,910		2.9
Leesburg area	1,216		0.5
Montgomery area	7,652		3.0

The ridges and lower slopes of mountains have been found to be especially well adapted to peaches. A number of successful commercial peach orchards are found on this soil. Many apple orchards have been planted on this type of soil, and some of them have already come into bearing. The adaptation of varieties to Hagerstown sandy loam is shown by the data which follows.

Variety	No. of growers reporting it.
York	28
Ben Davis	19
Winesap	16
Stayman Winesap	11
Arkansas	9
Grimes	8
Albemarle	7
Gano	3
Jonathan	1
Rome	1

Hagerstown loam is a brown or yellow loam 12 inches deep, underlain by a yellow clay loam to a depth of 24 inches,

and at greater depths grading into a stiff, yellowish-red clay. The type occupies rolling valleys and expands. It is widely distributed in the areas which have been surveyed.

Albemarle Area, Harrisonburg Sheet	11,776)	3.4
" " Waynesboro "	19,008)	
Montgomery area	22,400	8.9
Leesburg area	4,864	1.8
Bedford area	40,520	10.0

Hagerstown loam is well adapted to fruit growing where elevation, exposure and drainage are favorable. The following varieties of apples are reported on it: York, Stayman Winesap, Arkansas and Ben Davis.

Hagerstown clay loam is a heavy reddish loam or silty loam 24 inches deep, overlying stiff, tenacious red clay. The type occupies rolling valley land and is derived from the weathering of pure massive limestone.

This soil type occurs in the Montgomery area, where 1,792 acres are mapped which comprises only 0.7 per cent of this area. However the Hagerstown clay loam occurs in other parts of the Valley region. It is a good, strong soil and apples succeed well where exposure and elevation are favorable. The data below shows how varieties of apples are distributed on this soil.

Variety	No. of growers reporting it.
York	15
Ben Davis	12
Stayman Winesap	7
Winesap	6
Arkansas	4
Albemarle	3
Grimes	3
Jonathan	1
Black Ben Davis	1

Hagerstown clay is a heavy brown to reddish-brown loam or clay 12 inches deep, underlain by a stiff, tenacious reddish-yellow, or red clay. The type occupies rolling valley land and is derived from the weathering of pure massive limestone. It is widely distributed in the Valley region of the State.

	Area of Hagerstown Clay	Proportional extent per cent
	Acres.	
Albemarle area, Harrisonburg Sheet	25,920	2.9
Leesburg area	4,224	1.6
Bedford Area	19,210	4.8

Hagerstown clay is one of the strongest of the limestone soils. It is fertile and productive. Apples are grown rather extensively on this type of soil. The following data will give some idea of the adaptation of varieties.

Variety	No. of growers reporting it.
York	25
Ben Davis	22
Winesap	12
Grimes	11
Stayman Winesap	9
Arkansas	7
Black Ben Davis	5
Rome	3
Gano	2
Jonathan	1

There were some miscellaneous soil descriptions given; but these were not of sufficient extent to warrant any correlation between the soil type and the varieties of apples grown upon it. Hence, it does not seem worth while to discuss these miscellaneous soils.

Adaptation of Varieties to Soils.— I thought it was desirable to obtain the grower's opinion regarding the adaptation of varieties to soils. Therefore this question was propounded: "Do you find that certain varieties of apples are adapted to certain kinds of soil?"

This question was answered by 159 growers. Of this number 139 growers considered that certain varieties should be grown on particular types of soil and 20 considered that a given variety would do as well on one soil as another provided the soils were about equal in fertility.

The most striking adaptation met with is the case of Albemarle. This variety, as is frequently pointed out, succeeds best on the Porters series of soils in the mountain region. It is grown on other soil types, as certain members of the Cecil series; and indeed it was reported by a number of growers on the soils belonging to the Hagerstown series of the Valley region. But it does not succeed anywhere so well as on the mountain soil.

York grows well on nearly all kinds of soils that are

at all adapted to apples; but it does best on the soils of the Valley region.

Winesap finds its most congenial home on the soils of the Piedmont and Blue Ridge regions. Many growers had observed that Winesap is limited by soil types.

Jonathan, which is not well known in the State, succeeds well on the stronger types of soil in the Valley region.

Red apples are not as a rule so much affected by soil conditions as are other sorts.

PLANTING PLANS FOR ORCHARDS.

There are a number of systems in vogue for laying out orchards. Each has its advantages and none are free from disadvantages. The plans for orchard planting may be brought into three systems, each of which has various modifications.

(1) Rectangular. - According to this system the trees are set in rectangles or squares. This is a convenient plan for cultivation, spraying and other orchard operations. The main drawback to this plan is its waste of space. It does not utilize the land to best advantage. This plan is not well adapted to the filler system. A large majority of the orchards reported in this survey are planted on the rectangular or square plan.

(2) Quinaux. This is a good plan, though not commonly used by the growers. It is admirably adapted to the filler system. It consists in planting the trees in fives. On this plan, the permanent trees may be set in squares or rectangles, and a filler tree placed in the centre of each square or rectangle. This system utilizes the land to the very best advantage and by means of it about 75 per cent more trees may be planted on an acre of land than by the rectangular plan.

(3) Hexagonal. - This plan, in brief, consists of setting six trees equally distant in a circle and setting

one tree in the centre of the circle. It may be worked out with equilateral triangles. The advantage of this system is that all the trees are the same distance apart, and therefore the trees would receive equal amounts of sunlight, and food supply. This system is not well adapted to fillers. It will permit the setting of about 15 per cent more trees per acre than the rectangular system permits.

The table given below shows the number of trees which may be set on an acre of land at given distances by the three plans just discussed. (See Lewis, C. I., Orchard Management. Oregon Agrl. College Exp. Sta. Bullt. 111: p.18. 1911.)

Number of Trees Per Acre.

Distance Apart	Rectangular	Quinaux ⁿ	Hexagonal
16 x 16	170	303	196
18 x 18	134	239	154
20 x 20	108	192	124
22 x 22	90	148	104
24 x 24	76	132	87
25 x 25	70	125	80
26 x 26	64	114	74
28 x 28	56	100	64
30 x 30	48	85	55
32 x 32	43	76	49
33 x 33	40	71	46
36 x 36	34	60	39
40 x 40	27	48	32
45 x 45	22	39	25

Plans for Old Orchards. - The growers were asked regarding the plans on which their old orchards were planted, and the distance between the trees. The answers to this question are summarized in the following table.

System	Distance	Orchards Number	Per cent
Square	25 x 25 ft.	2	0.83
	27 x 27	1	0.42
	28 x 28	1	0.42
	30 x 30	67	27.92
	32 x 32	13	5.42
	33 x 33	32	13.33
	35 x 35	39	16.25
	36 x 36	10	4.17
	38 x 38	3	1.25
	40 x 40	39	16.25
	45 x 45	1	0.42
	50 x 50	1	0.42
Rectangular	20 x 40	2	0.83
	25 x 35	1	0.42
	28 x 34	1	0.42
	30 x 32	1	0.42
	30 x 35	1	0.42
	30 x 40	4	1.67
	32 x 37	1	0.42
	35 x 40	1	0.42
	36 x 40	1	0.42
	40 x 40	1	0.42
Quinceaux ^c	40 x 40	1	0.42
Alternate	40 x 40	2	0.83
	35 x 35	2	0.83
	30 x 33	1	0.42
	33 x 33	1	0.42
	30 x 30	2	0.83
Irregular or Haphazard		9	3.75

This table requires little comment. It shows the system of planting employed in the bearing orchards of the State and also the distance between the trees. The distances given refer to the permanent trees, not to fillers.

It is noticeable that the distance between the trees of many of the bearing orchards, more than twenty years old

is rather close. In the bearing orchards planted more recently distance between the trees is greater.

Fillers. - Less than a third of the old orchards were planted originally with filler trees; that is to say, trees which are to be removed when they begin to crowd the permanent trees. Forty-three growers stated that they used peaches as fillers, but did not name the varieties; eight planted apple fillers; three planted pear fillers and one planted plum fillers but did not name varieties. The varieties of apples employed for fillers are given in the table which follows:

Variety	Number of growers reporting it.
Ben Davis	5
Grimes	4
Bonum	3
Missouri	2
Jonathan	1
Yellow Transparent	1
Stayman Winesap	1
King David.	1

One grower thinks it is advisable to use dwarf apples (that is to say, varieties grafted on either Doucin or Paradise stocks) for fillers. They do not occupy so much space and they come into bearing earlier than standard trees. However, the practicability of this is very doubtful.

The varieties of peaches listed below were reported as fillers in apple orchards.

Variety	Number of growers reporting it.
Elberta	7
Oldmixon Free	4
Mountain Rose	3
Stump	3
Champion	2
Bilyeu	3
Early Crawford	2
Late Crawford	1
Salway	1
Triumph	1
Chinese cling	1
Smock	1
Heath	1

Plans for the young orchards. - The growers were asked for information regarding the system on which their young orchards were planted and distance between the trees. This data may be best set forth in the table which follows:

System	Distance (feet)	Orchards Number	Per cent
Square	25 x 25	3	1.45
	27 x 27	1	0.48
	30 x 30	45	21.74
	32 x 32	14	6.76
	33 x 33	23	11.11
	35 x 35	38	18.36
	36 x 36	9	4.35
	38 x 38	3	1.45
	40 x 40	25	12.08
Rectangular	44 x 44	1	0.48
	30 x 35	4	1.93
	32 x 37	5	2.42
	35 x 40	3	1.45
	36 x 40	7	3.38
	Miscellaneous	7	3.38
Alternate	20 x 40	3	1.45
	27 x 32	1	0.48
	30 x 30	1	0.48
	35 x 35	2	0.97
	40 x 40	2	0.97

Quincunx	30 x 30	2	0.97
	36 x 36	2	0.97
	40 x 40	1	0.48
Hexagonal	35 x 35	1	0.48
	30 x 30	2	0.97
Haphazard or Irregular		1	0.48

Fillers in young orchards.— The growers were questioned regarding the use of filler trees in young orchards.

The following is a summary of replies to this question.

System practiced	Number of growers so reporting.
No fillers used in young orchards	74
Peach fillers	53
Apple fillers	33
Pear fillers	5
Cherry fillers	1

More than half of the young orchards are interplanted with filler trees of some kind. It may be seen from the above table that there is a growing tendency to use apple trees of some suitable variety for fillers instead of peach trees for fillers.

Very few growers stated the varieties of peaches used as fillers in their young orchards. The table which follows gives the varieties of peaches mentioned by the growers who are using peach fillers in young orchards.

Variety	Number of growers who mentioned it.
Elberta	7
Smock	2
Bilyeu	2
Stump	1
Heath Free	1
Oldmixon Cling	1
Champion	1

There are a number of varieties of apples which are used as fillers in the young apple orchards. These are given below.

Variety	Number of growers mentioning it.
Grimes	6
Ben Davis	6
Bonum	4
Stayman Winesap	4
Jonathan	2
Missouri	2
Rome	2
Yellow Transparent	2
Gano	1
Arkansas	1
Northwestern Greening	1
Delicious	1
Smith	1
Oldenbrug	1
Raspberry	1
King David	1

TOP WORKING AND PROPAGATION.

Top grafting. - "Are any of your trees top grafted?"

Fifty-eight growers have trees that are top-worked for one reason or another. In many cases they had only a few trees top-worked; in a few cases orchards of considerable size were reported top-worked.

Table showing Varieties top-grafted onto other sorts.

Variety	No. of growers reporting it.
Winesap	6
Grimes	5
Delicious	3
Rome	2
King David	2
Stayman Winesap	2
Albemarle	2
Wolf River	1
Virginia Beauty	1
Winter Paradise	1
Esopus	1
Nickajack	1
Baldwin	1
Jonathan	1
Oldenburg	1

Table showing Varieties on which other sorts were top-grafted.

Variety	No. of growers reporting it.
Arkansas	3
Northern Spy	3
Ben Davis	2
Ivanhoe	1
Gibbs	1
Red Winesap	1
Nickajack	1
York	1
Albemarle	1
Delaware Red	1
Shockey	1

Where top-working was employed on an extensive scale, the growers chose some vigorous growing variety as a stock, as, for example, Arkansas or Northern Spy and on these strong trees a weaker variety as Grimes was top-worked later on. In many cases the choice of stock was incidental; the grower simply top-grafted some undesirable sort which happened to be in his orchard, either seedling trees untrue to name or odd varieties for which there is no market.

Varieties which should be top-grafted. - In order to get the growers viewpoint on this matter the following question was asked. "That varieties should be top-grafted?" Relatively few growers had had experience in top-grafting. This question brought forth about the same information that is given in the preceding paragraph. A number of growers stated that they thought it desirable to top-work seedlings, also varieties poor in color and quality or otherwise unprofitable. On the other hand, a number of growers were positive in the opinion that top-working old trees is a practice of doubtful practicability.

A number of growers were agreed as to the desirability of top-working Grimes on some strong, vigorous tree owing to the fact that this variety is subject to collar rot when root-grafted. There are two common practices by which this is accomplished. One method is to plant some strong-growing

variety, as Arkansas, and after one, two or three years top-work these young trees with cions of Grimes. Another, and more desirable method is to insert buds of Grimes into young trees of the variety to be used as the stock while those trees are still in the nursery. Several growers stated that Winesap, Stayman Winesap, and Rome make better growth when top worked than they do when root grafted.

The varieties most frequently recommended for stocks (that is, trees on which to work some other variety) are Arkansas, Spy, Baldwin and Ben Davis.

Selection of cions. - The following question was asked: "How are your cions selected?" I did not receive very many replies to this question, for most of the fruit growers buy their young trees direct from the nurseryman. But among the growers who propagate their own trees, we find that considerable care is exercised in selecting grafting wood. Data on this question is given below:

Method	No. of growers practicing it.
cions selected from bearing trees	21
cions cut from trees in the nursery	7
cions cut from young trees in the orchard	2
Miscellaneous selection	13

From these figures it may be seen that a few of the growers are giving attention to the source of the grafting wood. In recent years much has been written and said in regard to "pedigreed trees". It will be worth while for the

growers who have carefully selected cions from bearing trees of known quality and characteristics to compare their results with the results obtained in unselected orchards. Some prominent horticulturists claim that there is nothing in cion selection and "pedigreed trees".

An interesting paper has recently been published on this subject. (See Hedrick, U. P., Pedigreed Nursery Stock. New York Agr. Exp. Sta. (Geneva), circular No. 18, pp. 8. 1912). In this paper Professor Hedrick takes the position that the practice of some nurserymen of advertising "pedigreed trees" with "the actual blood record of every tree" is to be frowned upon by the growers. It must be borne in mind that a pedigreed fruit tree is a different proposition from pedigreed livestock or pedigreed seed. Apples are propagated asexually; and the case is not analogous to livestock or seed. Professor Hedrick concludes that it will not be wise for the fruit grower to demand pedigreed trees from the nurserymen.

At all events, there can be nothing lost by the fruit grower, who propagates his own trees, selecting his cions from bearing trees of known characteristics.

SPRAYING.

Spraying has become one of the common orchard operations and indeed it is necessary in order to grow high class fruit. In this survey the growers were asked several questions regarding spraying in order to determine the present status of this phase of orchard management in the state.

Dormant Spray. - "Do you give your trees a winter spraying?" This question was intended to cover the spraying done in the fall, winter or early spring while the trees are still dormant. The purpose of this is to kill scale insects and to give the trees a general cleaning. When applied late, that is just before the buds open, it is equally effective for scale and is also efficient for scab.

Of the 253 growers whose letters are used in this report, only 22 failed to answer this question. The replies to the question are tabulated below:-

	Number of growers so reporting	Per cent
Spray during the dormant season	207	89.61
Do not spray during dormant season	24	10.39

The growers who reported that they did not give a spraying during the dormant season, had, as a rule, young trees which were not in need of treatment.

The lime-sulphur solution is used by over 90% of the growers for the dormant spray. Many of the growers prepare

this solution at home according to the following formula:

15 lbs. sulphur
15 lbs. quicklime
50 gals. water

The lime is slackened with hot water, and while it is slackening the sulphur is poured in rapidly. After mixing, the amount of water is increased to 15 gallons, and then boiled briskly for 45 minutes. The most common practice is to prepare this solution in an open kettle. However, some growers have elaborate and convenient outfits for making lime-sulphur.

Commercial concentrate lime-sulphur solution is used by some growers for winter spraying. The commercial concentrate is diluted with water to the required strength.

A convenient table for making dilutions of the commercial concentrated lime-sulphur is found in Bulletin No. 320, of the New York Agri. Exp. Station, and is reported below in part.

Hydrometer reading	Baume	Sp. Gr.	Per cent sulphur in solution	Estim- ated value	Amount dilution recommended for San Jose scale		Apple and Pear (summer treatment for diseases)	Peach, Plume and cherry (summer treatment for diseases)
					Winter Spray	Water		
26	1.2184	19.76	\$7.87	1 gal.	5 3/4	23 gals.	92 gals	
27	1.2288	20.56	8.19	1 "	6	24 "	96 "	
28	1.2393	21.28	8.48	1 "	6 1/2	26 "	104 "	
29	1.2500	22.04	8.78	1 "	6 3/4	27 "	108 "	
30	1.2608	22.80	9.09	1 "	7	28 "	112 "	
31	1.2719	23.56	9.39	1 "	7 1/2	30 "	120 "	
32	1.2831	24.32	9.69	1 "	7 3/4	31 "	124 "	
33	1.2946	25.08	10.00	1 "	8	32 "	128 "	

Several spray mixtures besides lime-sulphur were reported for winter spraying. Several of the proprietary miscible or soluble oils have been used, as "scalecide", "Target Brand", "Kiloscale", "San-u-Zay", etc. Whole-sil soap and lye were used rarely.

There was no complaint from the use of the lime-sulphur solution; however there was some injury to the trees reported from the use of oils and lye when these preparations were not applied with proper precaution.

Summer spraying. - Under this topic the following question was asked: "How many times do you spray during spring and summer?" This question was intended to cover all the spraying done from the time the buds are open until the end of the spraying season. There were 217 answers to this question, and the replies are summarized in the table which follows.

	Number of growers so reporting	Per cent
One application	17	7.83
Two applications	50	23.04
Three applications	85	39.17
Four or more applications	65	29.95

From these figures it may be seen that the growers realize the importance of spraying. The number of applications of spray solution made during a given year will depend on the season and the variety of apples in question. Gener-

ally speaking three applications is enough for most red apples. Pippins require more. It is not infrequent that the growers who have the variety Albemarle, report making six or eight applications in one season; and one man stated that as a rule he sprayed his Albemarle trees twelve to fourteen times in a season.

Spray solutions for summer are discussed in the next paragraph.

Experience with Spray Solutions. - In order to get their estimate of the value of the different spray materials, the growers were asked the following question: "Give your experience with spray solutions". The following table shows what sort of spray materials the growers are using:

	Numbers reporting it	Per cent
Lime-sulphur (summer strength)	147	
Self-boiled Lime Sulphur	11	
Bordeaux Mixture	14	
Lime-sulphur followed by Bordeaux	47	
"Sulfocide"	3	
Atomic Sulphur	1	

Prior to the season of 1910, the fruit growers used Bordeaux mixture almost exclusively for summer spraying. As a result of the experiments conducted by Scott in 1909 making comparison between Bordeaux and Lime-sulphur as summer sprays a great change in spraying practice has taken place and during the summer of 1910, Lime-sulphur almost replaced Bordeaux except for bitter rot treatment, in which

case Bordeaux has proved to be more effective than Lime-sulphur. Bordeaux rusts the fruit of many varieties if applied while the apples are young; but can be applied later without injury.

Many growers give the first two summer sprays, viz. (1) the one just after the petals fall and (2) the one two weeks later with Lime-sulphur and later sprays are given with Bordeaux. This is frequently done in the pippin orchards which are subject to bitter rot.

Three growers had tried "Sulfacide" and one of these reported it unsatisfactory. The poison used with Sulfocide is Paris green; the manufacturers of this fungicide caution against the use of any other arsenical with this fungicide.

One grower had used "Atomic Sulphur" and reported it unsatisfactory.

For practically all summer spraying where a poison is desired against biting insects, arsenate of lead is used, and is generally applied along with the lime-sulphur solution of Bordeaux mixture as the case may be. Arsenate of lead has practically replaced Paris green in orchard spraying.

ORCHARD CULTIVATION AND MANAGEMENT.

Old or Bearing Orchards.— The bearing orchards are handled in various ways by different growers. In order to find out the most common methods in vogue the following request was made: "Describe briefly your system of cultivation for your old orchards". This request brought forth a varied series of replies. Very few growers handle their orchards in exactly the same manner. However the 213 answers* given may be grouped in systems as set forth in the table which follows:

System	No. of Orchards	Per cent
Sod	30	14.08
Sod Mulch	21	9.86
Clean tillage followed by cover crop	56	26.29
Clean tillage alone	36	16.90
Clean tillage for a period of years, then sod	5	2.35
Intermittent tillage with cover crop	21	9.86
Partial tillage	11	5.16
Tillage with a catch crop	33	15.49

From this data it may be seen that there are three main systems of management practiced in the bearing orchards, namely, sod, sod mulch, and tillage. These, together with their various modifications will be discussed briefly.

1. Sod. — In the orchard sod the surface soil is

* In some cases a grower might handle part of his orchard by one system and part by another.

held together by the matted roots of grass and other vegetation. The type of sod is very variable; it may consist of orchard grass, clover, timothy, blue grass, and in many cases a general mixture of grasses and weeds. In many of the Virginia orchards it is practically necessary to keep the orchard in sod. Many orchards are located on land that is steep and rough and the surface soil would be rapidly washed away if tillage were practiced regularly. It is almost necessary to keep vegetation on the land in order to hold the soil. These sod orchards are handled in various ways; some growers cut the grass and remove it as hay. Others pasture the orchard. I was interested to note that one man has a poultry ranch in his orchard. I am of the opinion that the poultry business will make a good combination with apple growing, and I hope more of our fruit growers will give attention to this matter. Many growers simply have their orchards in sod without touching them in any way, shape, or form. There are 14.08 per cent of the bearing orchards in sod.

2. Sod Mulch.- This term signifies the seeding of the land to grass and clover and mowing the same once or twice during the summer, leaving the cut grass to lie as a mulch under and around the trees. In contrast with this term we have the term "mulch", which consists in covering

the ground under and around the trees with some kind of coarse material which has not been grown in the orchard, as hay, straw, cornstalks, etc., and may be applied thick enough to prevent the growth of grass and weeds in the orchard. However, I am unable to distinguish between the sod mulch orchard and the mulch orchards reported in my survey. Both are lumped together. The sod mulch method is practiced in 9.86 per cent of the bearing orchards. In most cases the mulch is obtained by cutting the grass in the orchard and having the same as a mulch to lie on the ground. Several growers stated that they were using stable manure as a mulch. Some pasture the sod and top-dress with stable manure. There are other cases where the mulch is obtained by hauling into the orchard leaves, straw, etc.

3. Tillage.- By referring to the table given above, it may be seen that a large majority of the fruit growers, to be exact 76.05 per cent, are practicing tillage in one form or another in the management of their orchards.

Tillage should begin when the orchard is planted, and the entire surface of the land should be tilled. The most usual practice reported by the growers is to plow the land very early in the spring. It is important to get on the land early, in order to conserve the moisture which has accumulated in the soil during the winter and early spring.

This first plowing is followed up by the disc, cutaway, spring-tooth, or acme harrow or some suitable type of cultivator depending on circumstances. Shallow surface tillage should be kept up until about July 15th. At the last cultivation a cover crop is sown. There are several advantages to be derived from a cover crop. It unlocks plant food; it stops growth of the trees and causes them to ripen up their wood. There are times when it is not desirable to stop tillage in July. For example, in a very dry season, it may be very desirable to till right up to the fall season in order to conserve moisture.

Clean tillage is practiced in 26.29 per cent of the bearing orchards until about July 15th, at which time a cover crop is sown as outlined above. Clean tillage alone is practiced in 16.90 per cent of the orchards and after July 15th, weeds and grass are allowed to grow.

In 2.35 per cent of the bearing orchards clean tillage is practiced for a period of years and then methods of management are combined. One man would till every year until the orchard is eight years old; then till every third year, allowing the orchard to lie in sod the other two years. Another grower would till every year until the trees are seven years old and then mulch occasionally with stable manure.

Intermittent tillage is practiced in 9.86 per cent of the bearing orchards; that means the grower tills one year and then skips one or two or three or four or five years and then tills again. As a rule, however, they till every other year or every third year. The remainder of the time the orchard is left in sod, sod mulch, or handled by the mulch system.

In 5.16 per cent of the orchards, partial tillage is practiced. This is done in several ways. Some till a strip of land on either side of the tree-row; this is done to economize time and labor and expense. It is not as desirable as complete tillage. There are many cases where partial tillage is necessary; for example on very rough land, where it is almost impossible to plow, the grower may dig around his trees with a hoe.

In 15.49 per cent of the orchards tillage of the apple trees is accomplished by growing between the trees some kind of a catch-crop which requires surface cultivation at a time when the orchard requires tillage. Thus the grower "kills two birds with one stone". Catch-crops will be considered in a subsequent paragraph.

Young Orchards. - The following request was made: "Describe briefly your system of cultivation for your young orchard". Two hundred and eleven described their systems

(the same grower may have treated part of his orchard by one method and part by another, in which case he is counted twice in my calculations). These descriptions are briefly summarized in the table which follows:

System	Number of Orchards.	Per cent
Sod	2	0.95
Sod mulch	10	4.74
Clean tillage followed by cover crop	64	30.33
Clean tillage alone	35	16.59
Clean tillage for a period of years then sod	3	1.42
Intermittent tillage with cover crop	7	3.32
Partial tillage	11	5.21
Tillage with a catch-crop	79	37.44

The few growers who stated that they had no system of managing their young orchards are not included in the above table. A glance at the table shows that there are three dominant systems of management, and several others used in a lesser degree. I shall not go into details of tillage and sod methods since these were considered under old orchards.

Sod.- The sod method was reported in only 0.95 per cent of the young orchards. In one instance the grower was trying to get a stand of alfalfa in his young orchard.

Sod mulch. - The sod mulch method is practiced in 4.74 per cent of the young orchards. These are generally orchards on mountain land where cultivation is undesirable. These orchards are mulched in various ways, as by use of

stable manure, weeds, straw and bones.

Tillage. - The same types of tillage are met with here as in the old orchards.

In 30.33 per cent of the young orchards clean tillage is practiced up to July 1st, or 15th, at which time a cover crop is sown. A deep plowing is given in the late winter or early spring, followed up by shallow tillage in order to maintain a dust mulch. Some growers think it best to make the spring plowing shallow after the third year.

In 16.59 per cent of the young orchards clean tillage alone is practiced. Frequent surface tillage is kept up until July 15th, after which time the grass and weeds are allowed to come up and shade the land.

The owners of 1.42 per cent of the young orchards recommend clean tillage for a period of years, ranging from 5 to 8, allowing a sod to form at the end of this time.

Intermittent tillage is followed in 3.32 per cent of the orchards, that is the growers till the land every other year or every 3rd year, etc. The remainder of the time the orchard is in sod.

Partial tillage is carried on in 5.21 per cent of the orchards. Generally from 2 to 4 feet of soil on either side of the tree-row is kept tilled and sometimes a cover crop is sown at the end of the season of tillage. In a few

cases the young trees are worked with a hoe. Orchards in which hoe work is done are usually on rough land.

In 37.44 per cent of the young orchards the trees are tilled by means of growing a catch-crop in the young orchard. This seems to be a very common practice. Various catch-crops are grown as will be shown later. The fruit growers have given attention to the matter of rotation as well as fertilization in connection with the catch-crops. They seem to take great pains to return to the land the equivalent of the plant food removed by the catch-crop so that the trees may not suffer. A catch-crop, in many cases, helps to cover the expense of growing the trees to the bearing age.

Regardless of the system of tillage employed, the growers have laid great stress on the cover-crops.

Catch-Crops in the Commercial Orchards. - In order to find out to what extent catch-crops are grown in the orchards and what crops are most satisfactory for this purpose, the following question was asked: "Do you crop the orchard, if so what crop do you think most satisfactory".

One hundred and eighty-four growers answered this question. Twenty-four of these growers stated that they grew no crop for profit in their orchards; that is they took nothing off the land. A large majority of the growers take one crop or another from their orchards. This is done in

order to assist in defraying the expenses of cultivation until the orchard comes to that age when the apple crop itself is profitable. A summary of the replies to this question is given in the following table:

Crop	No. of orchards in which it is found	Crop	No. of orchards in which it is found
Corn	103	Soy beans	2
Potatoes	53	Timothy	2
Cow-peas	52	Rape	2
Clover 27)		Buckwheat	2
Red clover 1)	31	Vegetables	2
Crimson) clover 3)		Melons	1
Tomatoes	12	Strawberries	1
Tobacco	8	Turnips	1
Wheat	6	Canteloupe	1
Beans	5	Cabbage	1
Rye	5	Onions	1
Oats	4	"Truck Crops"	1
"Grass"	4	Sweet Potatoes	1
"Small Grain"	2		

184 growers gave data on this question.

24 of this number took no crop from the orchards.

From the above table it may be seen that corn is grown in a larger number of orchards than any other one crop. Very few fruit growers plant corn in old, or bearing orchards; for the trees shade the land to such an extent that the corn crop is poor and unprofitable; and furthermore the trees need the plant food which would be taken up from the soil by the growing crop of corn. It is a very common practice to grow corn in young orchards. The following sys-

tem of rotation is the one most commonly followed by the fruit growers: Corn is planted in the orchard the first year the apple-trees are set. In cultivating the corn, the orchardist also keeps his young trees cultivated. A space of several feet is left on either side of the tree-row. There is room between the tree-rows for about 5 rows of corn, depending upon the distance given the trees in the young orchard. The space left beside the trees is cultivated every time the corn is cultivated. At the last cultivation, which will generally be made in July, a cover-crop is seeded. Many sow rye in the fall after the corn crop is harvested. The rye protects the land through the winter. In the spring, after the rye has made a good growth, it is turned under, and about the last of June cow-peas are planted. The cow-peas are frequently planted in rows so they may be cultivated and at the time of last cultivation, crimson clover is seeded, which serves as a cover crop. The following spring, the crimson clover is turned under and potatoes are planted. After the potatoes are dug, a cover crop is seeded and the following year the rotation is begun again. There are various modifications of this system of rotation, both as regards the number of years and also the crops rotated with corn. Naturally, the growers decide this point according to local conditions. Some growers stated that they never

grew corn in their orchards after the first year, and they thought a crop of corn did no harm in the first year of the young orchard's life, provided the fertility of the land was properly conserved by subsequent methods of rotation and cultivation. Other growers were of the opinion that corn could be grown in the orchards until the trees came into bearing without danger of injuring the trees. One point emphasized by all who answered this question is the matter of rotation. None of the growers made a practice of following corn by corn successively. A few were growing corn every other year, but most of the growers had a three-year rotation.

Potatoes stand next to corn as a catch-crop for commercial apple-orchards. In localities where the potato does well, it has proved to be a very satisfactory catch-crop. It requires surface cultivation; it does not grow up high enough to shade the trees; it is not hard on the land; and it has generally been found profitable. No one pointed out any objections to growing potatoes in the orchard. I judge that the potato is one of the most satisfactory crops that can be grown in the orchard.

Cow-peas, the Clovers, Soy-beans, and Rape were reported by a number of growers. In some instances these crops are taken off the land as hay; in other cases they

are pastured. It seems to be a common practice to turn hogs into the orchard after the above crops have reached a certain stage and "hog down" the crop. This practice gives the soil the advantage of a leguminous crop and at the same time the hogs are prepared for market economically.

In some sections where a cannery is accessible, tomatoes have been found to be profitable catch-crops. The same may be said of beans and sugar corn.

Tobacco is grown in some of the orchards of the middle Piedmont region, particularly in Nelson, Bedford and Amherst counties. This crop is very satisfactory when grown in proper rotation.

Wheat, rye, oats and "small grain" were reported by several growers; but even the growers, who reported these crops, were of the opinion that it was not best to grow grain crops in the orchard.

Beans, "vegetables", melons, strawberries, turnips, canteloupes, cabbage, onions, "truck crops", and sweet potatoes are reported by a few growers. These growers were located near some town or city which furnished a local market for truck. The truck crops require hoe-cultivation and this keeps the surface of the soil thoroughly tilled. When these crops are taken off, the land is usually seeded to a cover crop, such as clover, vetch or rye. On the whole,

truck crops were reported as profitable and satisfactory.

"Grass" and timothy were reported by a few growers. These probably refer to taking a hay crop off the land where the orchard is in sod. In one section of the State buckwheat has given satisfaction as a catch-crop.

From the above data, it would seem that our fruit-growers have a large number of profitable crops from which they may choose profitable catch-crops, and in this choice they may be guided by local conditions, as the demand for the crop to be grown, adaptation of soil to the crop, time when the catch-crop requires attention, and the character of cultivation which the grower desires to give his apple-trees.

Sowing Cover-Crops. - In order to find out the prevalence of the practice of sowing a cover crop in orchard management, the following question was asked:- "Do you sow a cover-crop when the last cultivation for the season is made?" This question was answered by 190 growers. It was found that 87 per cent of these growers made a practice of sowing a cover-crop. This does not imply that they sow a cover-crop every year; but that they followed the practice when season and other conditions permitted. This means that they considered the practice desirable in orchard management. Only 13 per cent of the growers stated that they did not sow

a cover-crop. And it is easy to see why the practice can not be adapted in all cases, for some orchards are on rough land, that is not readily cultivated; in other cases the orchards are in sod and hence no cover-crop could be used.

Best cover-crop to sow. - In order to get the growers viewpoint on this matter the following question was asked: "What cover-crop is best?" One hundred and eighty-three persons answered this question. The grower frequently mentioned two or more cover crops and the table which follows gives a summary of all the answers.

Cover-Crop	No. of growers who mentioned it.
"Clover"	54
Crimson Clover	71
Red "	18
German "	5
Sapling "	4
Mammoth "	1
Alsike "	1
Cow-peas	49
Soy Beans	3
"Vetch"	4
Hairy Vetch	1
Sand Vetch	1
Rye	34
Rape	3
"Any legume"	1
Timothy	1
Orchard Grass	1
"Grass"	1
Buckwheat	1
Corn	2
Oats	1

From the above table it may be seen that the Clovers are by far the most popular cover-crops in the commercial

apple orchards. Crimson clover is most commonly grown. In many cases the sort of clover was not specified. Red clover, German clover and Sapling clover are mentioned quite frequently. Many growers spoke of the difficulty of obtaining clover seed during the seasons of 1910 and 1911, and even where seed could be had it was sold at a high price. There was complaint about obtaining a stand of crimson clover in the fall of 1910. This was probably due to a dry summer and fall. There was enough moisture in the land to enable the seed to germinate but not enough to enable the young seedlings to survive. One man writes "crimson clover is uncertain unless the soil has been limed."

Cow-peas are prominent among cover-crops. Cow-peas are planted the latter part of June when the last cultivation is made. The crop is then treated in several ways. In some instances a little corn is planted with it and late in the summer hogs are turned into the orchard to "hog down" the corn and peas. In other cases the peas are plowed under in the fall. In other cases they are simply left upon the land where they furnish a protective covering during the summer and fall, and the dead vines furnish more or less protection to the soil through the winter season.

Rye is not considered as good cover crop as the clovers, but rye is surer, and generally the grower can be sure that

he will get a crop when he sows rye. Some growers resort to the use of rye later in the fall if they see that the clover failed to "catch". Rye is sometimes grazed with sheep. Most growers turn the rye under green. Some growers recommend alternating rye with peas on successive years.

Some growers have tried vetch with satisfactory results. One man recommends sowing vetch with enough oats to hold it up.

Timothy, orchard grass and buckwheat are mentioned in combination with other cover crops.

MARKETING.

Where the Fruit is Sold. In order to obtain some definite information on this point the following question was asked: "What is your apple market"? This question was answered by the growers who have orchards in bearing. The following table shows a summary of the replies received to this question.

Markets	No. of growers shipping to them.
Southern Cities	28
Northern Cities	6
Middle western cities	11
Eastern cities	7
No. special market	16
Local Market	24
Export	24
Associations	9
Richmond	52
New York	38
Washington	18
Philadelphia	11
Baltimore	10
Roanoke	9
Pittsburg	8
Lynchburg	7
Cincinnatti	5
Chicago	3
St. Louis	3
Louisville	2
Cleveland	2
Winston-Salem	1
Columbus	1
Erie	1

In replying to this question, as may be seen from this table, a number of growers merely designated the locality of the market at which they sold in general terms, as northern cities, middle western cities, eastern or southern

cities, etc. Some had no special market. A number sold at local markets; this number included men whose orchards are near some town or city and generally their orchards were small. Some growers sell through associations and of course the associations sell at the market which demands fruit at that particular time wherever that may be. A majority of the export appears to go to England. Many of the apples which are sold in Richmond are put in storage there and later in the season reshipped to other cities, particularly southern cities.

It is interesting to note that so many growers are finding their markets in the south, Baltimore, Washington, Richmond and many other southern cities. Virginia fruit-growers have the advantage of proximity to the southern markets as compared to their competitors in the north and northwest fruit-growing regions.

Markets and Varieties. - "Does your market demand particular varieties?" The answers to this question do not bring out any very definite information, but they give some significant suggestions. Nearly half of the growers who answered this question were of the opinion that the markets were not particular as to the varieties provided the fruit was of good quality, clean and well packed. But other growers had observed that it pays to sell certain varieties in

certain markets.

Cities in Virginia prefer Winesap and Albemarle. Southern markets, as a rule, do not want Albemarle or any other light colored apple, but prefer red apples, as Winesap, York, Arkansas, Ben Davis and other large, red apples of attractive appearance. The export trade prefers Albemarle and York. The cities of the middle west have shown a preference for red apples. New York is a good market for fancy apples. Pittsburg demands a cheap apple.

How the Fruit is Sold. - "Do you sell your fruit at the orchard in lump to buyers, or do you sell through commission merchants, or do you sell direct to some fruit dealer?"

Answers to this question show that various methods are employed in selling. A grower frequently sells part of his crop by one method and part by another. A summary of replies to the above question is given in the table which follows:

Method of Selling	No. of Growers Using this Method
In lump to buyers	99
Fruit Jobbers	60
Commission Merchants	47
Cooperative Associations	17
Direct to Consumer	10
Storage (selling to jobbers later)	9
Miscellaneous	15

In the leading fruit centers of the State, buyers come to the orchards, examine the fruit while it is on the

trees and much fruit is sold in the orchards. Such sales are sometimes made in lump. Again, sales are made for a stated amount f. o. b., the buyer reserving the right to supervise the grading and packing.

How the Fruit is Packed. - "Have you packed any apples in boxes; if so with what success?"

The answers to this question indicate that a number of growers have tried the box package. The table which follows gives a summary of replies to this question.

Results obtained	N ^o . of growers who have tried the box package.
Very good	12
Good	22
Fair	3
Poor	7
Indifferent	5

From these figures it may be seen that over two thirds of the growers who have tried the box package met with good or very good success, while the other third reported fair, poor or indifferent success. Some of those who met with poor success attributed their failure to the fact that they were unable to pack the boxes well. Few growers have tried the box package on an extensive scale; generally their trials were made with a few hundred boxes. One man packed 1,100 boxes in the season of 1910 and lost money by doing so. Another man who has a large orchard of Winesaps and Albemarles, packs his entire crop in boxes

and considers that he greatly increases his profits by doing so. The latter grower understands the art of packing apples in boxes and does not have to depend upon inexperienced and untrained labor to do the packing.

Fourteen growers indicated that they expected to pack some of their apples in boxes in the future. Six growers were of the opinion that fancy apples, Albemarle, Winesap, and Stayman Winesap should be packed in boxes. The general opinion is that it is not worth while to pack apples of low grade in boxes.

The chief difficulties reported by the growers regarding the use of the box are (1) the markets do not particularly demand boxed apples; (2) the labor obtainable is inefficient for this work and consequently the packing is done poorly, and at greater expense than packing the same quantity of fruit in barrels. The latter difficulty may be overcome in a large measure by gradually training men to know the art of box packing.

The great bulk of Virginia apples is packed in barrels.

GENERAL CONSIDERATIONS.

Rapid Development of the Industry. - Within recent years, there has been a marked forward movement in commercial apple-orcharding in the State. The widespread and general extent of this development came out clearly in a question asked in this survey.

"Is commercial apple culture on the increase in your locality?" This question was answered by 235 growers; 229 answered it in the affirmative and 6 in the negative.

From every fruit section of the State the report comes that commercial apple growing is increasing. Many described this increase as a "boom" and "people have gone wild on the subject". Young trees that are being set are counted by the thousands and tens of thousands. Many people from other states and other countries are coming into Virginia and purchasing orchards or fruit lands on which to set young orchards. As a consequence of this great demand for orchards, land which is adapted to fruit growing has greatly increased in value.

Natural Drawbacks. - "Which are your greatest natural drawbacks, frost, insects, or diseases?"

Drawbacks	No. of growers so reporting
Insects	122
Diseases	81
Frost	51

Most prominent among the insect pests are Codling moth, San Jose scale, aphids, curculio, borers, etc. Most prominent among diseases are bitter rot, scab, cedar rust, and various leaf spots.

Insects of one sort or another and fungous diseases are always present. Systems of spraying and caring for the orchards have developed to the extent that these drawbacks can be controlled - at more or less expense and labor, to be sure, but they can be effectively remedied. From many sections of the state, reports of injury from frost are made. There are few frostless areas in the State. And after all, I suspect that frost is the greatest natural drawback against which the fruit growers have to contend.

Economic Difficulties. - What are your economic difficulties, labor or marketing?" There were only fourteen men out of the whole lot who had met with no particular economic difficulties. From the answers received it seems that labor is by far the most troublesome economic problem with which the commercial fruit grower has to deal. In many places it is difficult to get skilled labor. This is particularly true in the localities where the apple industry is just beginning to develop. There are many kinds of orchard work which require practice before the laborer attains efficiency at it. Such orchard work as spraying,

pruning, harvesting and packing, is not usually done either rapidly or thoroughly by a new hand at the business. Laborers who have grown up in the orchard are far more efficient and satisfactory than raw hands. Communities in which orcharding is an old and well established business do not have a serious difficulty with inefficient labor.

In some sections, there is complaint of scarcity of labor and high wages demanded by the laborers. The farmer who grows fruit as an exclusive farm product, can not employ labor through the entire year. There are times when he needs a great deal of labor and there are times when there is no way for him to keep his labor profitably employed. The result is, he must keep just a few men all the year and depend on picking up extra help in the busy season, for example at harvesting time. The evidence at hand seems to indicate that a combination of fruit growing with some other type of farming is the most economic method of management.

Many growers find marketing an economic difficulty. This is a question of many phases. The simplest solution of this problem is to sell the fruit to the apple buyers who come to the orchard. But the grower does not know what his fruit is worth. It is almost impossible for the individual grower to keep in touch with the markets. One man expressed this well when he said "I don't know how to get in touch

with the markets at the right time". Some think that cooperative selling through associations is the solution to the marketing problem. I think there can be no doubt that organization of the fruit growers is necessary and will each year become more necessary as the industry develops. However, it is not to be overlooked that there are difficulties even in organization.

The growers who are having most difficulty with the marketing problem at the present time are those whose orchards are distant from a shipping point. There are many orchards in the State as much as twelve, fifteen and even twenty miles from a shipping point. As competition becomes stronger, the disadvantage of distance becomes more noticeable and besides, the roads in rural sections are poor as a rule, which makes hauling still more difficult.

A number of growers complain of high transportation rates on the railroads. Individuals or associations who ship only in car-load lots have a decided advantage over growers who ship in small and broken lots.

General Remarks and Suggestions from the Growers. - The growers were asked to give suggestions regarding the fruit growing industry in the State. I will merely give the substance of these suggestions in the few paragraphs which follow.

Choose a good location for the orchard. You must have a fruit soil to begin with. There must be good drainage; if the land is not well drained naturally, drainage must be provided for artificially. The orchard site must have air drainage as well. In low places, orchards suffer far more from frost than do those which have good air-drainage. The profits from orchards on very rough land are becoming less as competition grows stronger. Several growers suggest that apple trees should not be planted on land that is too steep to drive a wagon over. The cost of cultivation, spraying and harvesting is greatly increased on rough and steep land.

Choose varieties which are adapted to the soil and locality. This is not easy to do in localities where apples have not been grown. In the well established fruit centers accumulated experience has shown what varieties are standard sorts for that locality. Plant only a few varieties, and only standard varieties in a commercial orchard. Exception to this rule is made in case of orchards intended to supply a local or special market.

When the orchard is planted, it must be cared for properly. Cultivation, pruning, fertilization and spraying must be done well and at the right time. To win success, the fruit grower must produce good, clean apples. The grower must see to it that apples are produced at a cost which

will yield him a profit and at the same time allow the consumer to purchase them at a moderate price.

The questions of grading and packing were emphasized from every point of view. Thorough grading and harvest packing are the corner stones of successful marketing. The kind of package is of small consequence compared to the character of the fruit in it.

Many growers made suggestions regarding organization and cooperative action in the business. There was a general agreement regarding the desirability for organization but there were differences of opinion as to the best method for obtaining the end desired.

Some growers who are just beginning the business express the feeling that lack of experience in the work is the cause of many expensive errors.

In many ways, a sentiment was expressed by the growers favoring a conservative substantial development of the great fruit interests of the State as opposed to the spirit of speculation in orcharding.

THE TREND OF APPLE PLANTING IN VIRGINIA.

My Dear Sir :--

In connection with my studies in the Graduate School of Cornell University, I am making an investigation with the object in view of determining the trend of apple planting in the State of Virginia. My purpose is to bring together definite information regarding varieties which are most popular in the newer plantings, and to compare these with varieties found in old orchards. In like manner, I wish to compare the methods of planting the young orchards with the methods used in setting out the older orchards. I am asking also for information regarding cultivation and spraying

In connection with this survey, an examination of the adaptation and quality of varieties themselves will be made. This will help us to determine the relative importance of varieties, and their probable influence on the development of the fruit industry in Virginia.

The general conclusions which may be derived from the information obtained by this survey will be made available to the fruit growers at an early date. I hope to publish it either in the Report of the Virginia State Horticultural Society, or in some other accessible publication.

I therefore hope that you will feel disposed to co-operate heartily in this matter. Please answer the following questions as completely as possible. I enclose an envelope (addressed and stamped) for reply.

I take this opportunity to thank you in advance for the courtesy,

A. W. DRINKARD, Jr.,
Graduate Student.

Approved : John Craig, Professor of Horticulture, in Cornell University.

[Note: After two years I will resume my duties as assistant in the department of horticulture at the Virginia Agricultural Experiment Station.—A. W. Drinkard, Jr.

QUESTIONS.

[Please answer the questions as far as possible and omit those which do not apply to your conditions.]

1. How many acres have you planted to apple trees?
2. Name the leading varieties of apples in your bearing orchard in order of their commercial [that is, money making] importance to you giving approximate number of each.
3. Name the varieties in your orchard not yet bearing in order of their commercial importance, giving approximate number of each.
4. a. What varieties of apples would you plant if you were to extend your orchard? [State reason for this selection.]
- making
- smoking
- b. How many varieties do you think it profitable to grow?
5. Does climate or any other factor, as elevation, soil, insects or diseases peculiar to your locality, limit you to certain varieties.
6. a. What varieties resist scale most successfully?
- b. What varieties are most susceptible to scale?
- c. What varieties resist disease most successfully?
- d. What varieties are most susceptible to disease?
7. a. Give a brief description of the soil in your orchard [state whether sandy, sandy loam, clay loam, **heavy clay**, light clay, color, etc., and state character of subsoil]
- b. Do you find that certain varieties of apples are adapted to certain kinds of soil?

8. How are your old orchards planted, Square or alternate?

Distance apart?

Age of trees?

Were they planted with or without fillers?

If with fillers, state distance of permanent trees.

State distance of fillers.

Name varieties [whether apples or peaches] used as fillers.

9. On what system is your young orchard planted?

How far apart are the trees?

If on filler system, distance of permanent trees.

Distance of fillers.

Varieties [whether apple or peaches] used as fillers?

10. Are any of your trees top grafted?

11. What varieties should be top grafted?

12. How are your cions selected?

13. a. Do you give your trees a winter spraying?

b. How many times do you usually spray during spring and summer?

c. Give your experience with spray solutions.

14. Describe briefly your system of cultivation,

a. For your old orchard.

b. For your young orchard.

c. Do you crop the orchard, if so what crop do you think most satisfactory? .

d. Do you sow a cover crop when the last cultivation for the season is made?

e. What cover crop is best?

15. Marketing,

a. What is your apple market?

b. Does that market demand particular varieties?

c. Do you sell your fruit at the orchard in lump to buyers, or do you sell through commission merchants, or do you sell direct to some fruit dealer?

d. Have you packed any apples in boxes, if so with what success?

16. Is commercial apple-culture on the increase in your locality?

17. Are growers using fewer or more varieties than formerly?

18. What are your greatest natural drawbacks, frost, insects or diseases?

19. What are your economic difficulties, labor or marketing?

20. General remarks and suggestions.

Signed by

Postoffice address

County

Date

